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Demographic and Diagnostic Outcomes of Patients Undergoing Neuro-Electrophysiological Evaluation: A Retrospective Analysis

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Abstract

Background: *Neuro-electrophysiological evaluations play a crucial role in diagnosing a wide spectrum of neuromuscular disorders. This study aimed to assess the demographic characteristics and diagnostic patterns of patients undergoing neuro-electrophysiological evaluations.*

Methods: *This retrospective observational study was conducted in the Neurophysiology Laboratory of National Institute of Neurosciences & Hospital, Dhaka, Bangladesh from September 2024 to August 2025. In this study, a total of 1,500 patients referred for neuro-electrophysiological assessment for various neurological symptoms who underwent evaluation within the study period were included. Neuro-electrophysiological tests included nerve conduction studies (NCS), electromyography (EMG), repetitive nerve stimulation (RNS), and visual evoked potential (VEP).*

Results: *The mean age of the study population was 37.96 ± 16.31 years, with nearly half (49%) aged 19–40 years. Males comprised 55.07% of participants, reflecting a slight male predominance. NCS was the most frequently performed investigation (68%), followed by combined NCS–EMG (28.07%). Normal neuro-electrophysiological findings were observed in 28.53% of cases. Carpal tunnel syndrome (CTS) was the most common abnormal diagnosis (27.53%), with bilateral involvement slightly higher than unilateral. Sensorimotor polyneuropathy (41.35%) was the predominant PN subtype. Among GBS cases, AIDP was the most common variant (54.01%). In the MND–ALS group, definite disease accounted for 83.13% of cases. Segmental AHC disease was the leading subtype among anterior horn cell disorders (64.20%). Ulnar neuropathy was the most frequent mononeuropathy (45.61%). Non-inflammatory myopathy (86.67%), brachial plexopathy (93.10%), and lumbosacral radiculopathy (73.33%) were the most prevalent subtypes in their respective categories.*

Conclusion: *This study highlights the diverse diagnostic spectrum encountered in neuro-electrophysiological evaluations, with CTS, polyneuropathy, and GBS representing major contributors. Understanding these patterns can improve diagnostic accuracy and guide patient management.*

Keywords: *Neuro-electrophysiology, Polyneuropathy, CTS, GBS, MND-ALS, Myopathy*

1. INTRODUCTION

Neuropathy is not a single disease entity but a manifestation of nerve damage arising from a wide range of underlying medical conditions. In some cases, no identifiable cause can be determined, and such presentations are termed idiopathic neuropathy. The term "neuropathy" generally refers to peripheral neuropathy, which affects nerves outside the central nervous system [1]. Peripheral nerves are broadly categorized into autonomic, motor, and sensory fibers, each responsible for vital functions. Autonomic nerves control involuntary processes such as gut motility, bladder function, heart rate, blood pressure, and sweating. Motor nerves regulate voluntary muscle movements, whereas sensory nerves transmit sensations such as touch, temperature, and pain from the body to the brain [2].

Peripheral neuropathy may result from diverse etiologies including physical trauma, repetitive use injuries, infections, metabolic disorders, toxin exposure, and certain medications. Diabetes mellitus remains the leading cause globally, followed by chronic liver disease, chronic kidney disease, HIV/AIDS, long-term alcohol misuse, vitamin B and other nutritional deficiencies, malignancies such as lymphoma or multiple myeloma, Lyme disease, and immune-mediated conditions like Guillain-Barré syndrome (GBS) [2]. GBS is widely recognized as an autoimmune disorder triggered by antecedent infections, commonly Campylobacter jejuni, cytomegalovirus, Epstein-Barr virus, and Mycoplasma pneumoniae. Molecular mimicry plays a central role in the acute motor axonal neuropathy (AMAN) variant, where immune responses cross-react with peripheral nerve components, leading to axonal injury. In acute inflammatory demyelinating polyneuropathy (AIDP), immune-mediated attacks on Schwann cells or myelin cause demyelination [2].

Carpal tunnel syndrome (CTS) is the most prevalent entrapment neuropathy, resulting from compression of the median nerve within the carpal tunnel [3]. Elevated tunnel pressure, mechanical traction, impaired venous return, and ischemia contribute to nerve dysfunction [4]. Recent anatomical evidence also highlights the role of myofascial stress on the paraneural sheath in CTS pathogenesis [5].

Neuro-electrophysiological investigations are essential tools for diagnosing neuromuscular disorders. Nerve conduction study (NCS) assesses the speed and strength of electrical signals transmitted along peripheral nerves. During the procedure, surface electrodes deliver mild electrical impulses to stimulate the nerve, and the resulting activity is recorded to evaluate conduction velocity and amplitude. Notably, NCS reflects the function of the best-preserved nerve fibers; thus, results may appear normal despite underlying neuropathy in some cases [6]. Electromyography (EMG), often performed alongside NCS, evaluates muscle electrical activity using fine needle electrodes. Reduced motor unit responses may indicate neuropathic damage [7]. Both tests are complementary and help differentiate between nerve and muscle disorders [8].

Repetitive nerve stimulation (RNS) is a key diagnostic modality for myasthenia gravis (MG), although its sensitivity varies depending on disease severity and muscle involvement [9,10]. MG is an autoimmune disorder of the neuromuscular junction characterized by antibodies targeting the acetylcholine receptor (AChR), muscle-specific kinase (MuSK), or low-density lipoprotein receptor–related protein 4 (LRP4) [11]. Visual evoked potential (VEP) testing evaluates the functional integrity of the visual pathway from the retina to the occipital cortex and assists in diagnosing disorders such as multiple sclerosis, traumatic optic neuropathy, and optic nerve tumors [12].

Accurate neurological diagnosis requires a comprehensive clinical evaluation supported by targeted investigations. Because many neurological disorders produce symptoms distant from the primary site of pathology, electrophysiological testing plays a crucial role in differentiating motor from sensory involvement, distinguishing axonal from demyelinating pathology, and clarifying whether upper or lower motor neurons are affected.

Given these diagnostic challenges, the present study aimed to assess the demographic characteristics and electrophysiological diagnostic patterns of patients undergoing neuro-electrophysiological evaluations, including NCS, EMG, RNS, and VEP.

2. METHODOLOGY & MATERIALS

This retrospective observational study was conducted in the Neurophysiology Laboratory of National Institute of Neurosciences & Hospital, Dhaka, Bangladesh from September 2024 to August 2025. In this study, a total of 1,500 patients referred for neuro-electrophysiological

assessment for various neurological symptoms who underwent evaluation within the study period were included.

These were the following criteria for eligibility as study participants:

2.1. Inclusion Criteria

- Individuals of any age or sex who underwent at least one of the following investigations: NCS, EMG, RNS, or VEP.
- Patients with complete demographic records and electrodiagnostic reports.
- Cases referred for evaluation of suspected neuromuscular, peripheral nerve, or motor neuron disorders.

2.2. Exclusion Criteria

- Individuals with incomplete demographic data or missing final electrodiagnostic interpretation.
- Patients whose neuro-electrophysiological studies were technically inadequate or non-interpretable.
- Repeat evaluations of the same patient within the study period (only the first complete study was analyzed).
- Patients evaluated solely for intraoperative monitoring or non-neuromuscular indications.

2.3. Data Collection Procedure

Data were collected retrospectively from laboratory records, electronic databases, and archived neurophysiology reports using a structured data extraction form to ensure uniformity. Variables recorded included demographic details (age, sex, religion), the type of neuro-electrophysiological investigation performed (NCS, EMG, combined NCS–EMG, RNS, VEP), the final diagnostic impression, and subtype classifications for major diagnostic categories such as CTS, polyneuropathy, GBS, mononeuropathy, myopathy, MND–ALS, AHC disease, plexopathy, and radiculopathy.

All electrophysiological studies were conducted by experienced neurologists or trained neurophysiology technologists following standard protocols under temperature-controlled conditions, and diagnoses were made using established criteria, including AIDP/AMAN/AMSAN classification for GBS and severity grading for CTS. After extraction, all data were systematically cleaned, coded, and entered into a secure database for statistical analysis.

2.4. Data Analysis

All data were recorded systematically in an excel file. Quantitative data were expressed as mean and standard deviation, and qualitative data were expressed as frequency distribution and percentage.

The data were analyzed using SPSS 23 (Statistical Package for Social Sciences) for Windows version 10. This study was ethically approved by the Institutional Review Committee of National Institute of Neurosciences & Hospital.

3. Results

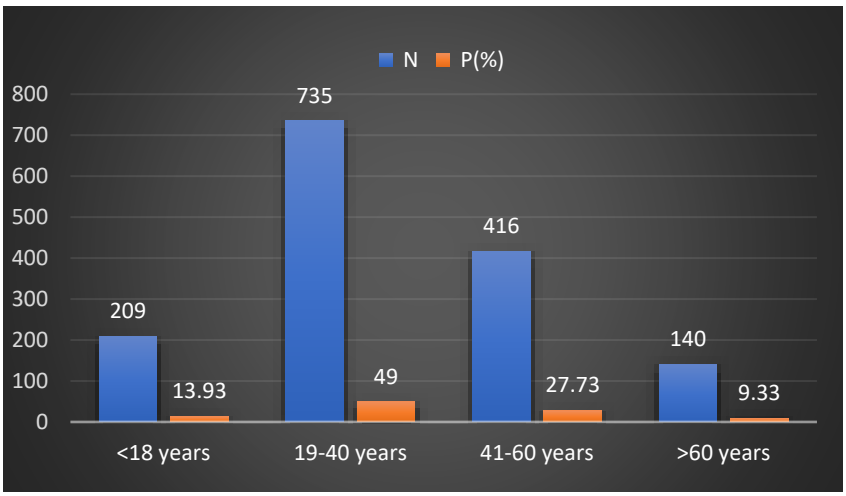

Figure 1. *Age Distribution of Study Patients*

Figure 1 shows the age distribution of patients undergoing neuro-electrophysiological evaluation. Most participants were 19–40 years old (49%), followed by 41–60 years (27.7%). Those below 18 and above 60 years comprised 13.9% and 9.3%, respectively.

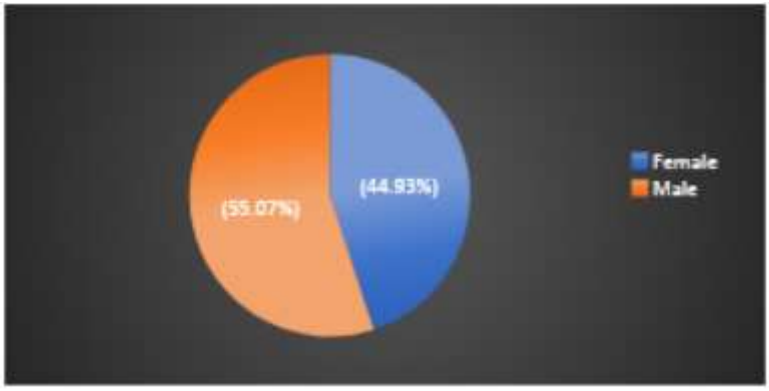

Figure 2. *Gender Distribution of Study Participants*

The pie chart shows the gender distribution of the study participants. Among the 1500 patients who underwent neuro-electrophysiological evaluation, 826 (55.07%) were male and 674 (44.93%) were female, indicating a slight male predominance.

Table 1. *Demographic Characteristics and Investigation Profile of the Study Patients (N = 1500)*

Variables	N	P(%)
Mean age (years)	37.96±16.31	
Gender (Male: Female)	1.2: 1	
Religion		
Islam	1429	95.27
Hindu	69	4.60
Type of Investigation		
NCS	1020	68.00
NCS & EMG	421	28.07
RNS	48	3.20
VEP	11	0.73

Table 1 summarizes patient characteristics and investigation types. The mean age was 37.96 ± 16.31 years, with a male-to-female ratio of 1.2:1. Most patients were Muslim (95.3%), with Hindus comprising 4.6%. Nerve conduction study (NCS) was most common (68%), followed by combined NCS and EMG (28.1%), while RNS and VEP were performed in 3.2% and 0.7% of patients, respectively.

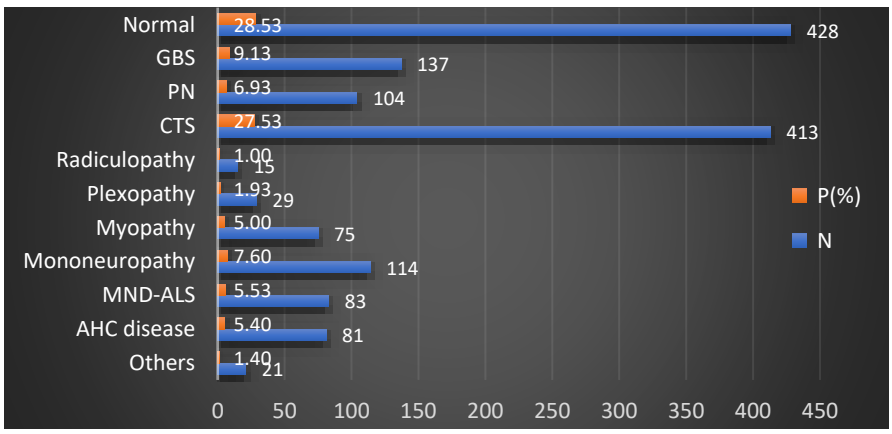

Figure 3. *Distribution of Neuro-electrophysiological Diagnoses among the Study Patients*

Figure 3 shows the distribution of diagnoses among study participants. Normal results were most frequent (28.5%), followed by carpal tunnel syndrome (27.5%). Other notable findings included Guillain-Barré syndrome (9.1%), mononeuropathy (7.6%), polyneuropathy (6.9%), MND/ALS (5.5%), myopathy (5.0%), and anterior horn cell disease (5.4%). Less common diagnoses were plexopathy (1.9%), radiculopathy (1.0%), and miscellaneous disorders (1.4%).

Table 2. *Distribution of Carpal Tunnel Syndrome (CTS) Cases by Laterality and Severity (N = 413)*

Type	N	P(%)
Unilateral	**n = 201**	**48.67**
Mild	104	51.74
Moderate	47	23.38
Severe	50	24.88
Bilateral	**n = 212**	**51.33**
Mild	73	34.43
Moderate	78	36.79
Severe	61	28.77
Total	**413**	**100.00**

Table 2 summarizes CTS cases among 413 patients. Bilateral involvement was slightly more common (51.3%) than unilateral (48.7%). In unilateral CTS, mild cases predominated (51.7%), followed by severe (24.9%) and moderate (23.4%). For bilateral CTS, moderate cases were most frequent (36.8%), followed by mild (34.4%) and severe (28.8%).

Table 3. *Distribution of Polyneuropathy (PN) Subtypes among the Study Patients (N = 104)*

Subtype	N	P (%)
Sensorimotor Polyneuropathy	43	41.35
Pure Motor Polyneuropathy	27	25.96
Pure Sensory Polyneuropathy	18	17.31
HMSN	12	11.54
CIDP	4	3.85
Total	**104**	**100.00**

Table 3 shows PN subtypes identified via neuro-electrophysiological evaluation. Sensorimotor PN was most common (41.4%), followed by pure motor (26.0%) and pure sensory (17.3%). Less frequent variants included HMSN (11.5%) and CIDP (3.9%).

Table 4. *Distribution of Guillain–Barré Syndrome (GBS) Subtypes among the Study Patients (N = 137)*

Subtype	N	P (%)
AIDP (Acute Inflammatory Demyelinating Polyneuropathy)	74	54.01
AMAN (Acute Motor Axonal Neuropathy)	49	35.77
AMSAN (Acute Motor and Sensory Axonal Neuropathy)	14	10.22
Total	**137**	**100.00**

Table 4 shows the distribution of GBS subtypes identified through neuro-electrophysiological testing. The AIDP subtype was the most common (54.01%), followed by AMAN (35.77%) and AMSAN (10.22%).

Table 5. *Distribution of Motor Neuron Disease (MND–ALS) Subtypes*

Subtype	N	Percentage (%)
Definite	69	83.13
Probable	11	13.25
Possible	1	1.20
Progressive Bulbar Palsy	2	2.41
Total	**83**	**100.00**

Table 5 presents the distribution of subtypes among patients diagnosed with Motor Neuron Disease (MND–ALS). The majority were classified as Definite MND–ALS (83.13%), followed by Probable (13.25%) and Possible cases (1.20%). A smaller subgroup (2.41%) was diagnosed with Progressive Bulbar Palsy.

Table 6. *Distribution of Anterior Horn Cell (AHC) Disease Subtypes*

Subtype	N	P (%)
Segmental	52	64.20
SMA	17	20.99
PMA	11	13.58
Post-Polio	1	1.23
Total	**81**	**100.00**

Table 6 summarizes AHC disease subtypes among 81 patients. Segmental AHC disease was most common (64.2%), followed by SMA (21.0%), PMA (13.6%), and post-polio syndrome (1.2%).

Table 7. *Distribution of Mononeuropathy Types among Study Participants*

Type of Mononeuropathy	N	P (%)
Ulnar	52	45.61
Peroneal	25	21.93
Median	19	16.67
Radial	13	11.40
Sciatic	2	1.75
Others	3	2.63
Total	**114**	**100.00**

Table 7 shows mononeuropathy distribution among 114 patients. Ulnar neuropathy was most common (45.6%), followed by peroneal (21.9%) and median (16.7%). Less frequent types included radial (11.4%), sciatic (1.8%), and other rare mononeuropathies (2.6%).

Table 8. *Distribution of Myopathy, Plexopathy, and Radiculopathy Types*

Myopathy Type	N=75	P (%)
Non-inflammatory	65	86.67
Myotonic dystrophy	8	10.67
Inflammatory	2	2.67
Total	75	100.00
Plexus Type	**N=29**	**P (%)**
Brachial	27	93.10
Lumbosacral	2	6.90
Total	29	100.00
Radiculopathy Type	**N=15**	**P (%)**
Lumbosacral	11	73.33
Cervical	4	26.67
Total	15	100.00

Table 8 shows that non-inflammatory myopathy predominated (86.7%), followed by myotonic dystrophy (10.7%) and inflammatory myopathy (2.7%). In plexopathies, brachial plexus involvement was most common (93.1%), while lumbosacral plexus accounted for 6.9%. For radiculopathy, lumbosacral cases were more frequent (73.3%) than cervical (26.7%).

4. Discussion

In the present study, nearly half of the participants (49%) were between 19 and 40 years of age, followed by 27.73% in the 41–60 years age group. Patients below 18 years accounted for 13.93%, while those above 60 years constituted 9.33% of the cohort. The mean age was 37.96 ± 16.31 years, with a male-to-female ratio of 1.2:1. Similar age and sex distributions have been reported in previous studies. Tomschik et al. noted that most cases of peripheral neuropathy occurred in individuals in their fourth to fifth decade, with a male predominance, a pattern echoed by several other studies [13–15].

In line with this, our study also found a slight male predominance: 826 males (55.07%) and 674 females (44.93%). Akhlaque et al. similarly observed that 56% of their study population were

males [16]. Ekayanti et al. reported an equal male-to-female ratio (50:50), with a mean age of 43.3 ± 13.4 years, and found that males had higher mean anthropometric measurements compared to females [17].

Regarding the types of investigations performed, nerve conduction studies (NCS) were the most common (68%), followed by combined NCS and EMG (28.07%). Repetitive nerve stimulation (RNS) and visual evoked potentials (VEP) were performed in a smaller percentage of patients (3.2% and 0.73%, respectively).

The most frequent diagnosis in our study was carpal tunnel syndrome (CTS), comprising 413 cases (27.53%). Other common findings included Guillain-Barré syndrome (GBS) (9.13%), mononeuropathy (7.60%), polyneuropathy (6.93%), and motor neuron disease/ALS (5.53%). However, normal electrophysiological findings were observed in 428 patients (28.53%). Akhlaque et al. reported an even higher proportion of normal studies (44%), with 56% showing electrophysiological abnormalities [16]. Previous literature indicates diabetic polyneuropathy and compressive neuropathies particularly CTS as the most common clinical diagnoses, while diabetes remains the leading non-compressive etiology [18, 19]. Axonal neuropathy is often the predominant pattern, followed by mixed and demyelinating types [14, 20–22].

In comparison, Akhlaque et al. found that 13% of their patients had polyneuropathy, with hereditary sensorimotor neuropathy (HSMN) being the most frequent subtype (59%) [16]. They also reported varying GBS subtypes, including AIDP, AMSAN, and AMAN. Their findings further showed that among patients diagnosed with myopathy, 29% had dystrophic and 71% had non-dystrophic myopathy, while anterior horn cell disorders included spinal muscular atrophy and poliomyelitis cases.

In the present study, myopathy and anterior horn cell (AHC) disease were identified in 75 (5.0%) and 81 (5.40%) cases, respectively. Less frequent diagnoses included plexopathy (1.93%), radiculopathy (1.00%), and other miscellaneous conditions (1.40%). Among pediatric patients, hereditary sensory motor polyneuropathy was the most common polyneuropathy in children aged 6–10 years. Similar age-specific patterns have been reported in other studies, including a Pakistani study by Zia et al., which found that demyelinating forms of GBS were more common in children [23]. Orhan et al. also reported myopathy (9.4%) as a frequent electrophysiological diagnosis in younger children [24].

In the 10–15-year age group in our study, mononeuropathy (20%) was the most common diagnosis. Orhan et al., however, observed polyneuropathy as the predominant condition in this age group [24]. The higher frequency of mononeuropathy in our context may be attributed to iatrogenic injection neuritis and post-traumatic nerve injuries. Although injection-induced neuropathy occurs worldwide, its incidence appears disproportionately high in our setting. This may reflect gaps in healthcare quality, particularly in rural and low-socioeconomic regions, where inadequately trained healthcare workers and unsafe injection practices remain common [25].

5. Limitations Of The Study

This study has several limitations. As a retrospective, single-center analysis, the findings may not be fully generalizable to other populations or healthcare settings. Diagnostic accuracy depended on the quality and completeness of archived reports, which may introduce documentation bias. Additionally, the study did not assess interobserver variability in test interpretation, which may influence diagnostic categorization.

6. Conclusion And Recommendations

This retrospective analysis provides valuable insights into the demographic patterns and diagnostic outcomes of patients undergoing neuro-electrophysiological evaluation at a tertiary care center. The findings highlight a predominance of young to middle-aged adults, with a slight male majority among those referred for testing. Normal electrophysiological findings and carpal tunnel syndrome emerged as the most frequent diagnostic outcomes, followed by GBS, mononeuropathy, polyneuropathy, MND–ALS, myopathy, and AHC diseases. Subtype analysis further revealed substantial heterogeneity within major diagnostic categories, underscoring the utility of neuro-electrophysiological studies in differentiating neuromuscular disorders. Overall, the study emphasizes the crucial role of electrophysiological testing in early diagnosis, classification, and clinical decision-making for a wide spectrum of neurological conditions.

Future prospective studies incorporating detailed clinical profiles, follow-up data, and treatment outcomes are recommended to establish stronger correlations between electrophysiological findings and disease progression.

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