INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

SPECTRUM OF PATIENTS REPORTING FOR ELECTRODIAGNOSTIC STUDIES AT TERTIARY CARE REHAB SETUP

Original Research

Waqas Khalil[1]*, Nadeem Ahmad[2], Zaheer Gill[3], Syed Tameem Ul Hassan[4], Waseem Iqbal[5], Uzma Aftab[6]

[1]MBBS, Resident Physical Medicine and Rehabilitation, Armed Forces Institute of Rehabilitation Medicine/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

[2]MBBS, FCPS, Consultant Physical Medicine and Rehabilitation, Armed Forces Institute of Rehabilitation Medicine/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

[3]MBBS, FCPS, Consultant Physical Medicine and Rehabilitation, Combined Military Hospital Lahore/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

[4]MBBS, FCPS, Consultant Physical Medicine and Rehabilitation, Combined Military Hospital Kohat/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

[5]MBBS, FCPS, Consultant Physical Medicine and Rehabilitation, Combined Military Hospital Multan / National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

[6]MBBS, FCPS, Consultant Physical Medicine and Rehabilitation, Combined Military Hospital Rawalpindi/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan.

Corresponding Author: Waqas Khalil, MBBS, Resident Physical Medicine and Rehabilitation, Armed Forces Institute of Rehabilitation Medicine/ National University of Medical Sciences (NUMS) Rawalpindi Pakistan, khalilwaqas0054@gmail.com

Acknowledgement: The authors gratefully acknowledge the support of the staff and patients of the Armed Forces Institute of Rehabilitation Medicine.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Neuromuscular disorders (NMDs) comprise a broad group of conditions affecting the peripheral nervous system, muscles, neuromuscular junctions, and motor neurons. Timely diagnosis is critical to prevent disability and optimize treatment. Electrodiagnostic studies, including electromyography (EMG) and nerve conduction studies (NCS), play a pivotal role in evaluating patients with suspected NMDs. However, limited access to these diagnostic services in developing countries hinders early and accurate identification of such conditions.

Objective: To evaluate the clinical indications and electrodiagnostic profiles of patients with neuromuscular disorders referred to the electrophysiology and electrodiagnostic department of a tertiary care rehabilitation center.

Methods: A cross-sectional observational study was conducted at the Military Tertiary Care Rehabilitation Center, Rawalpindi, from January 1 to August 1, 2024. A total of 610 patients referred for electrodiagnostic evaluation with suspected NMDs were enrolled. Inclusion criteria encompassed all age groups and genders. Patients with psychosis, severe psychiatric illness, contraindicated implanted devices, active bleeding disorders, or significant dermatological conditions were excluded. Detailed demographic and clinical histories were recorded, followed by standardized EMG and NCS testing performed by certified neurophysiologists. Data were analyzed using SPSS version 26, employing descriptive and inferential statistics.

Results: Of the 610 patients, 51.7% were male and 48.3% female. Age distribution included 15.0% below 18 years, 37.6% between 18–40 years, 31.3% between 41–63 years, and 16.1% over 63 years. Abnormal electrodiagnostic findings were observed in 91.63% (n=559) of cases. Radiculopathies were the most common diagnosis (32.1%), followed by carpal tunnel syndrome (17.3%), peripheral neuropathies (15.1%), and peripheral nerve injuries (13.0%). Hereditary and inflammatory neuropathies were notable subtypes, and neuromuscular junction disorders were identified in 4.8% of patients.

Conclusion: The findings underscore the diagnostic utility of electrodiagnostic studies in identifying neuromuscular disorders and highlight the urgent need for their accessibility in resource-constrained settings. Further research integrating genetic and biochemical assessments is warranted to improve patient outcomes.

Keywords: Electromyography, Nerve Conduction Studies, Neuromuscular Junction Disorders, Neuromuscular Diseases, Peripheral Nervous System Diseases, Rehabilitation Centers, Radiculopathy.

INTRODUCTION

Neuromuscular diseases (NMDs) encompass a diverse group of disorders that affect components of the peripheral nervous system, neuromuscular junctions, motor neurons, and skeletal muscles. These conditions often manifest with hallmark symptoms such as hypotonia, respiratory compromise, and persistent fatigue, ultimately impairing mobility and daily functioning. Among the most prevalent NMDs are congenital myopathies, muscular dystrophies, spinal muscular atrophies, and Myasthenia Gravis, all of which pose significant challenges to motor abilities and quality of life (1). Despite advancements in clinical neurology, the global prevalence of hereditary and acquired neuromuscular disorders remains relatively low, with an estimated frequency ranging from 1 to 10 cases per 100,000 individuals (2). However, this modest prevalence belies the profound functional and psychosocial impact these diseases impose on affected individuals and their families. Timely and accurate diagnosis is critical in the management of neuromuscular diseases, guiding both prognostication and therapeutic decision-making (3). Electrodiagnostic techniques, particularly nerve conduction studies (NCS) and needle electromyography (EMG), represent the cornerstone of diagnostic evaluation in suspected cases of NMD (4). These tests are typically performed in tandem and serve as extensions of the clinical neurological examination rather than replacements. By facilitating the identification of the anatomical site of dysfunction—be it neurogenic, myopathic, or neuromuscular junction-related—these modalities significantly enhance diagnostic precision. Moreover, electrodiagnostic findings often contribute valuable insights into the severity, progression, and potential responsiveness to treatment (5,6).

Despite the recognized utility of electrodiagnostic investigations, access remains inequitable in many developing nations. In Pakistan, for instance, such services are predominantly restricted to select private facilities in metropolitan areas, rendering them inaccessible to a significant portion of the population due to prohibitive out-of-pocket costs (7). This financial and geographical disparity underscores a broader systemic challenge in delivering specialized neurological care. Nevertheless, a major step forward has been the revitalization of the Electro Diagnostic Department at the Military Tertiary Care Rehabilitation Center in Rawalpindi, which now operates as the largest rehabilitation facility of its kind in South Asia (8). The center provides NCS and EMG services to military personnel and their families at subsidized or no cost, representing a unique opportunity to evaluate the spectrum of neuromuscular disorders in this population. Surprisingly, there is a scarcity of published epidemiological data on neuromuscular diseases in Pakistan, despite the growing clinical burden. The absence of large-scale, local studies limits both clinical understanding and policy development for these conditions (9,10). Addressing this gap, the present study aims to evaluate the clinical indications and electrodiagnostic profiles of patients with suspected neuromuscular disorders referred to the electrophysiology and electrodiagnostic unit at the Military Tertiary Care Rehabilitation Center. The findings are expected to not only enhance the current understanding of disease patterns within the region but also lay the groundwork for future research and resource planning.

METHODS

This cross-sectional observational study was conducted at the Electro Diagnostic Department of the Armed Forces Institute of Rehabilitation Medicine (AFIRM), Rawalpindi, Pakistan. The study spanned a data collection period from January 1, 2024, to August 1, 2024. The study population comprised patients referred from various departments and hospitals for electrodiagnostic assessment, including nerve conduction studies (NCS) and electromyography (EMG), based on clinical suspicion of neuromuscular disorders. A non-probability convenient sampling technique was utilized to enroll eligible participants. Inclusion criteria encompassed patients of all ages and both genders presenting with signs and symptoms suggestive of neuromuscular disease and referred for electrodiagnostic evaluation. Exclusion criteria included individuals with a known history of psychosis or severe psychiatric illness, those with implanted electronic devices incompatible with electrodiagnostic procedures (such as pacemakers or neurostimulators), patients with uncontrolled coagulopathies or those on anticoagulant therapy, and individuals with dermatological conditions at the electrode application or needle insertion sites, such as severe dermatitis or cellulitis. Each participant underwent a structured clinical assessment, which was documented using a pre-designed proforma capturing demographic data, medical and neurological history, and the referring diagnosis (11). Electrodiagnostic procedures were performed by board-certified and experienced neurophysiologists using internationally standardized techniques. Electromyography involved both needle and surface methods: needle EMG was performed by inserting fine electrodes into muscle tissues to record resting and voluntary electrical activity, while surface EMG utilized adhesive electrodes placed on the skin to

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

measure the muscular response to nerve signals. These tests were instrumental in differentiating neuropathic from myopathic patterns and assessing neuromuscular junction disorders.

Nerve conduction studies were conducted by placing surface electrodes along peripheral nerves and administering controlled electrical stimuli to assess sensory and motor nerve function. Parameters such as latency, conduction velocity, and response amplitude were recorded to evaluate axonal integrity and myelin sheath status. All procedures were conducted under standardized operator-dependent protocols to ensure uniformity across patient evaluations. In addition to initial assessments, patients were routinely scheduled for clinical follow-ups every three months as per departmental practice. These follow-ups included a review of evolving symptoms, treatments received, repeat electrodiagnostic testing (if indicated), and any further interventions. While the data collection for this study was limited to a 7-month period, patients were enrolled from an ongoing clinical service where longitudinal follow-up, including annual reassessments, is part of standard patient care. This institutional protocol provided supplementary context to individual patient trajectories, particularly in those undergoing multiple diagnostic assessments during the data collection window.

Data were entered into a secure, encrypted, and password-protected digital database. Statistical analysis was carried out using IBM SPSS Statistics for Windows, Version 26. Descriptive statistics were applied to summarize demographic and clinical data, while inferential statistics were used to explore associations between variables. Continuous variables were expressed as means and standard deviations, and categorical variables as frequencies and percentages. The study was approved by the Research and Ethical Review Board of the Armed Forces Institute of Rehabilitation Medicine (AFIRM-ERC), under reference number RE_05/2023, dated July 7, 2023. The study adhered strictly to the principles outlined in the Declaration of Helsinki. All participants provided informed written consent before enrollment, with confidentiality and voluntary participation assured throughout the study period.

RESULTS

A total of 610 patients were registered during the study period, with a nearly equal gender distribution of 51.7% males (n=315) and 48.3% females (n=295). The age distribution showed that 15.0% (n=92) of patients were under 18 years, 37.6% (n=229) were between 18 and 40 years, 31.3% (n=191) were between 41 and 63 years, and 16.1% (n=98) were above 63 years. Regarding disease duration, 34.4% (n=210) had symptoms for less than 1 year, 36.0% (n=220) for 1 to 3 years, and 29.6% (n=189) had symptoms for more than 3 years. Most of the patients (74.8%, n=456) were ambulatory, while 25.2% (n=154) were wheelchair users. Referrals were most commonly for radiculopathy (32.6%, n=199), followed by post-traumatic complications (18.5%, n=113), motor-related issues (16.5%, n=101), sensory disturbances (14.8%, n=90), and unspecified reasons (17.6%, n=107). Electrodiagnostic findings revealed that 91.6% (n=559) of the referred patients had abnormal test results, while only 8.4% (n=51) showed normal studies. Among the confirmed neuromuscular disorders, radiculopathies were the most prevalent diagnosis, observed in 32.1% (n=186) of the cohort. Carpal tunnel syndrome accounted for 17.3% (n=100), followed by peripheral neuropathies in 15.1% (n=87), peripheral nerve injuries in 13.0% (n=75), Guillain-Barré Syndrome in 6.6% (n=38), neuromuscular junction disorders in 4.7% (n=27), myopathies in 4.3% (n=25), and motor neuron diseases in 3.6% (n=21).

Within radiculopathy cases (n=186), cervical radiculopathy was the most frequently diagnosed type, reported in 57.5% (n=107), followed by lumbar radiculopathy in 41.9% (n=78), and thoracic radiculopathy in 0.6% (n=1). In terms of myopathies (n=25), hereditary myopathies accounted for 40% (n=10), inflammatory myopathies for 36% (n=9), and acquired myopathies for 24% (n=6). Peripheral neuropathies (n=87) were predominantly diabetic in origin, seen in 79.3% (n=69) of the cases. Charcot-Marie-Tooth (CMT) disease was identified in 57 individuals, representing 82.6% within the hereditary neuropathy category. Other unspecified forms of peripheral neuropathies were found in 12 participants (17.4%), while 18 patients (20.7%) were categorized under hereditary neuropathies. Neuromuscular junction disorders (n=27) included Myasthenia Gravis in 48.1% (n=13), Parkinsonism in 18.5% (n=5), and unspecified disorders in the remaining 33.4% (n=9). Among the motor neuron disorders (n=21), post-polio syndrome was the most prevalent, comprising 52.2% (n=12) of these cases.

Additional analysis revealed valuable correlations between clinical indications and electrodiagnostic outcomes. Among patients referred for radiculopathy-related complaints (n=199), the majority were diagnosed with confirmed radiculopathies (n=100), followed by carpal tunnel syndrome (n=20) and peripheral neuropathies (n=15). Similarly, those referred for motor-related issues most frequently had radiculopathies (n=30), carpal tunnel syndrome (n=15), or myopathies (n=10). Sensory complaints were predominantly linked to radiculopathies (n=25) and peripheral neuropathies (n=20), while patients with post-traumatic complications most commonly showed signs of peripheral neuropathies (n=25), radiculopathies (n=20), or normal findings (n=51). The group with unspecified referrals demonstrated a more even distribution across all categories, suggesting diagnostic ambiguity. A subgroup analysis based on gender and

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

age revealed further patterns. Males aged 18–40 and 41–63 years had the highest incidence of radiculopathies (n=40 and n=35, respectively), followed by females in the same age brackets (n=38 and n=36, respectively). Carpal tunnel syndrome was notably higher in females aged 18–40 (n=18) and 41–63 (n=28), indicating a potential gender-linked predisposition. Peripheral neuropathies peaked in older males aged 41–63 (n=20) and females in the same group (n=17), reflecting the age-related burden of diseases like diabetic neuropathy. Myopathies were scattered across all subgroups but slightly more frequent in middle-aged individuals, particularly males aged 41–63 (n=6) and females aged 18–40 (n=5).

Table 1: Demographic and disease-related characteristics of the study sample (n=610)

Variables	n	Percentage (%)
Gender		
Male	315	51.7
Female	295	48.3
Age (Years)		
<18	92	15.0
18-40	229	37.6
41-63	191	31.3
>63	98	16.1
Duration of Disease		
<1 year	210	34.4
1-3 years	220	36.0
>3 years	189	29.6
Mobilization		
Walking	456	74.8
Wheelchair	154	25.2
Referral Basis		
Post-traumatic complications	113	18.5
Motor issues	101	16.5
Sensory issues	90	14.8
Radiculopathy	199	32.6
unspecified	107	17.6

Table 2: Distribution of Radiculopathies and myopathies among the cases

classification	n	%
Radiculopathy	186	33.3%
Cervical	107	57.5%
Lumbar	78	41.9%
Thoracic	1	0.6%
Myopathy	25	4.4%
Acquired myopathies	6	24%
Inflammatory myopathies (IIM)	9	36%
Hereditary myopathies	10	40%

Table 3: Distribution of peripheral Neuropathies among confirmed cases (n=87)

Classification	N	%
Diabetic neuropathy	69	79.3%
Charcot-Marie Tooth (CMT)	57	82.6%
Others	12	17.4%
Hereditary neuropathy	18	20.7%

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Table 4: Subgroup Analysis by Gender and Age Group

Age Group	Gender	Radiculopathies	Peripheral Neuropathies	Carpal Tunnel	Myopathies
<18	Male	20	5	2	1
18-40	Male	40	15	20	3
41-63	Male	35	20	15	6
>63	Male	18	10	5	2
<18	Female	15	4	3	2
18-40	Female	38	10	18	5
41-63	Female	36	17	28	4
>63	Female	24	6	9	2

Table 5: Comparison of Clinical Indications and Electrodiagnostic Findings

Clinical Indication	Radiculopathies	Peripheral Neuropathies	Carpal Tunnel	Myopathies	Normal Findings
Post-traumatic	20	25	10	7	51
Motor issues	30	12	15	10	34
Sensory issues	25	20	10	5	30
Radiculopathy	100	15	20	3	15
Unspecified	11	15	5	0	20

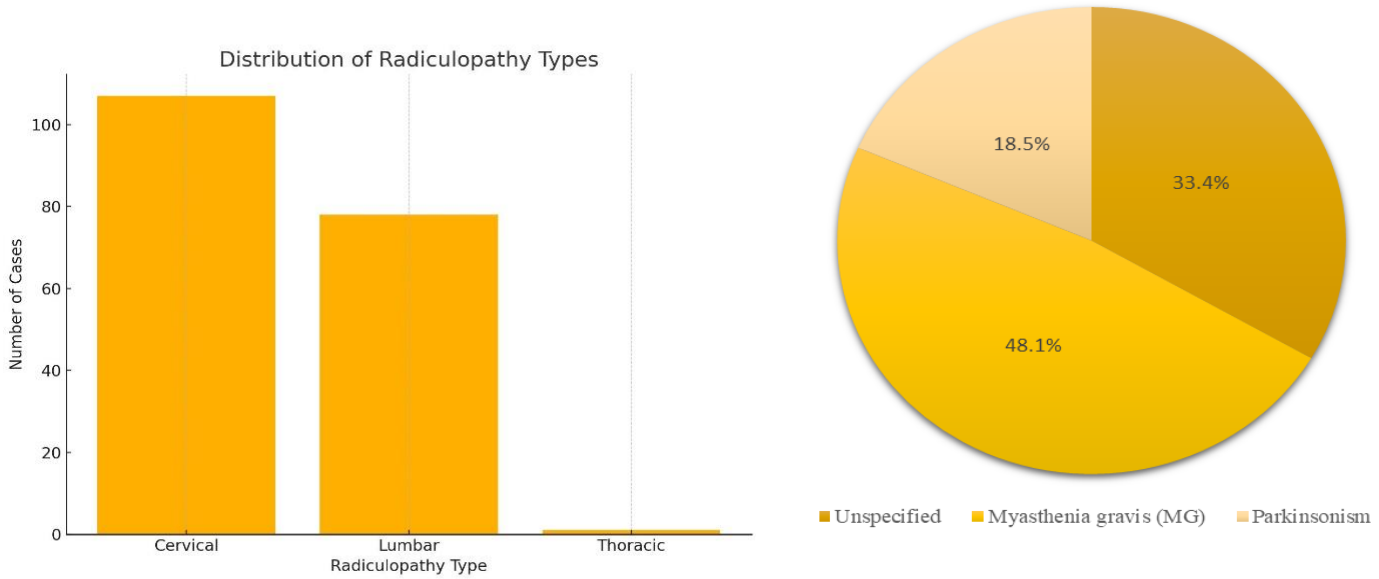

Figure 1 Distribution of Radiculopathy Types

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

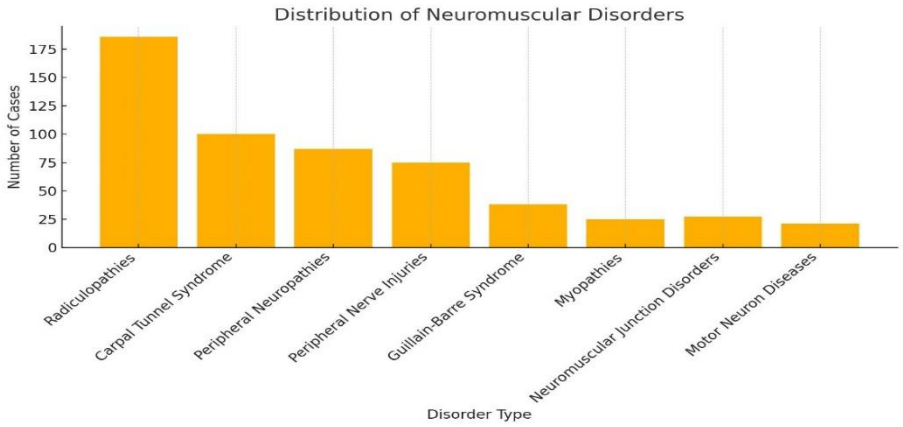

Figure 2 Distribution of Neuromuscular Disorders

DISCUSSION

Patients presenting with neuromuscular complaints often remain undiagnosed or inadequately managed due to limited access to affordable and widely available electrodiagnostic services, particularly in low- and middle-income countries. This study, the first of its kind from one of the largest public rehabilitation centers in South Asia, provides a comprehensive review of referral patterns and electrodiagnostic profiles of patients evaluated for suspected neuromuscular disorders (12). The findings contribute significantly to the understanding of the burden, diagnostic spectrum, and potential gaps in neuromuscular care within a public healthcare setting. The high rate of abnormal electrodiagnostic findings (91.6%) highlights the critical role of these investigations in confirming neuromuscular disorders that may otherwise be clinically ambiguous. This aligns with global data reporting high diagnostic yields of electrodiagnostic testing in neuromuscular evaluations (13). Radiculopathies emerged as the most frequently diagnosed condition, accounting for 32.1% of all cases, and were also the most common referral indication. This predominance reflects their close association with degenerative spine diseases and trauma-related pathologies, consistent with previous studies reporting similar epidemiological trends in neuromuscular clinics (14). Post-traumatic complications and peripheral nerve injuries were also among the top diagnostic categories, reinforcing the relevance of electrodiagnostic assessment in post-injury neuromuscular evaluation. The diverse spectrum of electrodiagnostic findings—ranging from carpal tunnel syndrome (17.3%) and peripheral neuropathies (15.1%) to rarer entities such as motor neuron diseases and neuromuscular junction disorders—demonstrates the versatility and clinical value of electrodiagnostic tools in differentiating conditions with overlapping clinical features. Within muscle disorders, acquired myopathies were more prevalent than hereditary or inflammatory forms. This distribution corresponds with existing literature emphasizing the contribution of external factors such as metabolic derangements, drug toxicities, critical illnesses, and infections—including SARS-CoV-2—to the development of acquired myopathies (15,16). Electrodiagnostic insights in such conditions offer a practical advantage by identifying subclinical muscle involvement, which may otherwise go unrecognized, particularly in ICU settings.

The study also identified a considerable proportion of hereditary and inflammatory neuropathies among peripheral nerve disorders. This reinforces the need for genetic and immunological workups, particularly in younger patients or those with atypical presentations. Integrating genetic testing into neuromuscular diagnostic pathways has been shown to improve diagnostic precision and facilitate tailored interventions (17). Although neuromuscular junction disorders such as Myasthenia Gravis were less prevalent in this study, their detection remains critical due to the significant morbidity they pose and the specialized therapies they require (18). The presence of a substantial proportion of patients with unspecified or mixed-type neuromuscular disorders points to the complex nature of these conditions and underscores the necessity of multidisciplinary approaches that include imaging, serological studies, and genetic testing alongside electrodiagnosis (19). The present study provides robust data from a large, diverse patient cohort and benefits from a structured methodology and standardized electrodiagnostic protocols. Its primary strength lies in offering the first region-specific insight into referral patterns and diagnostic outcomes within a major public rehabilitation setting, where care is subsidized or free—eliminating the usual socioeconomic barriers to electrodiagnostic access (20). However, the study also has limitations. The cross-sectional design precluded follow-up of diagnostic outcomes or treatment responses, which would have provided a more dynamic understanding of the clinical impact of the diagnoses made. Additionally, while referral reasons and diagnostic outcomes were correlated, clinical severity,

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

comorbidities, and treatment data were not included, which limits the ability to draw conclusions about prognostic or therapeutic implications.

Furthermore, the lack of routine genetic, serological, and imaging adjuncts in the diagnostic process may have contributed to the classification of some disorders as unspecified, particularly within neuromuscular junction and hereditary categories. Future studies should incorporate longitudinal follow-up and integrate multidisciplinary assessments, including genetic and immunological diagnostics, to provide a more holistic view of neuromuscular disease patterns and their trajectories. Subgroup analyses based on gender and age, as conducted in this study, have demonstrated epidemiological nuances that may guide more focused screening and intervention strategies. However, more granular analyses, such as occupational and environmental exposures or lifestyle-related risk factors, would further enrich future research. In conclusion, the findings reaffirm the indispensable role of electrodiagnostic studies in the early and accurate diagnosis of neuromuscular disorders. Establishing structured referral systems and expanding access to these diagnostic modalities across resource-limited settings could significantly reduce the burden of delayed or missed diagnoses. The integration of genetic and biochemical testing alongside electrophysiological evaluations is a crucial next step toward personalized, efficient, and evidence-based neuromuscular care.

CONCLUSION

This study highlighted the broad clinical spectrum of neuromuscular disorders encountered in a major public rehabilitation center, emphasizing the diagnostic utility of electrodiagnostic evaluations in identifying both common and complex conditions. The predominance of radiculopathies, along with the notable presence of hereditary and inflammatory neuropathies, underscores the need for integrated diagnostic strategies that combine electrodiagnosis with genetic and immunological assessments. By mapping referral patterns and electrodiagnostic outcomes, this research contributes valuable insights into the neuromuscular disease landscape and reinforces the importance of accessible, specialized diagnostic services to ensure timely and accurate patient care.

Author Contribution

Author	Contribution
Waqas Khalil*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Nadeem Ahmad	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Zaheer Gill	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Syed Tameem Ul Hassan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Waseem Iqbal	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Uzma Aftab	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

REFERENCES

1. Robinson LR. Traumatic injury to peripheral nerves. Muscle Nerve. 2022;66(6):661-70.
2. Goutman SA, Hardiman O, Al-Chalabi A, Chió A, Savelieff MG, Kiernan MC, et al. Recent advances in the diagnosis and prognosis of amyotrophic lateral sclerosis. Lancet Neurol. 2022;21(5):480-93.
3. Shefner JM, Al-Chalabi A, Baker MR, Cui LY, de Carvalho M, Eisen A, et al. A proposal for new diagnostic criteria for ALS. Clin Neurophysiol. 2020;131(8):1975-8.
4. Rubin DI. Needle Electromyography Waveforms During Needle Electromyography. Neurol Clin. 2021;39(4):919-38.
5. Tannemaat MR, Huijbers MG, Verschuuren J. Myasthenia gravis-Pathophysiology, diagnosis, and treatment. Handb Clin Neurol. 2024;200:283-305.
6. Hannaford A, Vucic S, van Alfen N, Simon NG. Muscle ultrasound in hereditary muscle disease. Neuromuscul Disord. 2022;32(11-12):851-63.
7. Lamb CJ, Rubin DI. Electromyography Case Examples: Practical Approaches to Neuromuscular Symptoms. Neurol Clin. 2021;39(4):1097-111.
8. Electromyography and Neuromuscular Disorders: Clinical-Electrodiagnostic-Ultrasound Correlations, Fourth Edition. J Clin Neurophysiol. 2021;38(4):e19.
9. Marquardt RJ, Levin KH. Electrodiagnostic Assessment of Radiculopathies. Neurol Clin. 2021;39(4):983-95.
10. Martinez-Thompson JM. Electrodiagnostic Assessment of Myopathy. Neurol Clin. 2021;39(4):1035-49.
11. Patel K, Horak HA. Electrodiagnosis of Common Mononeuropathies: Median, Ulnar, and Fibular (Peroneal) Neuropathies. Neurol Clin. 2021;39(4):939-55.
12. Vianello A, Racca F, Vita GL, Pierucci P, Vita G. Motor neuron, peripheral nerve, and neuromuscular junction disorders. Handbook of clinical neurology. 2022 Jan 1;189:259-70.
13. Khan SJ, Asif M, Aslam S, Khan WJ, Hamza SA. Pakistan's healthcare system: a review of major challenges and the first comprehensive universal health coverage initiative. Cureus. 2023 Sep;15(9).
14. Zewde YZ, Ayele BA, Belay HD, Oda DM, Gelan YD, Kelemu FT, Gugssa SA, Mengesha AT. Electrodiagnostic referrals and neuromuscular disease pattern in East Africa: experience from a tertiary hospital in Ethiopia. Clinical Neurophysiology Practice. 2022 Jan 1;7:65-70.
15. Rawat M, Kostopoulos D, Rizopoulos K, Dodson W, Blair K, Henderson J, Grow M, Upreti C. Impact of electrodiagnostic (EMG/NCS) tests on clinical decision-making and patient perceived benefit in the outpatient physical therapy practice. Journal of Bodywork and Movement Therapies. 2020 Jan 1;24(1):170-4.
16. Schänzer A, Dittmayer C, Porubsky S, Weis J, Goebel HH, Stenzel W. Neuropathology I: muscular diseases. Pathologie (Heidelberg, Germany). 2022 Dec 2;44(2):104-12.
17. Uy, G.G.G.C., Rosales, R.L. and Khadilkar, S., 2023. Treatable Myopathies.
18. Awad M, Al-Hussaniy HA, Alburghaif AH, Tawfeeq KT. The role of COVID-19 in myopathy: incidence, causes, treatment, and prevention. Journal of Medicine and Life. 2022 Dec;15(12):1458.
19. Al Sultani H, Hafeez K, Shaibani A. Diagnostic Outcome of Genetic Testing for Neuromuscular Disorders in a Tertiary Center. Journal of Clinical Neuromuscular Disease. 2022 Sep 1;24(1):1-6.
20. Estephan ED, Baima JP, Zambon AA. Myasthenia gravis in clinical practice. Arquivos de neuro-psiquiatria. 2022 May;80(5 Suppl 1):257-65.