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Declarations

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Spectrum of Neurological Disorders in Patients Visiting Tertiary Care Hospitals in Peshawar

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ABSTRACT

Background: Neurological disorders represent a major cause of global morbidity and disability, particularly in low- and middle-income countries where epidemiological data remain limited. Pakistan faces a growing burden of epilepsy, headache syndromes, and cerebrovascular diseases, yet region-specific data from Khyber Pakhtunkhwa are scarce. **Objective:** To determine the frequency and demographic distribution of neurological disorders among patients attending tertiary care hospitals in Peshawar, Pakistan, and to identify the most prevalent disease categories across age and gender groups. **Methods:** A descriptive cross-sectional study was conducted from July to October 2022 at Lady Reading Hospital, Khyber Teaching Hospital, and Hayatabad Medical Complex. All patients presenting to neurology outpatient and inpatient departments were included following diagnostic confirmation. Data on demographics, clinical diagnosis, and family history were collected using a structured questionnaire and analyzed in SPSS version 22. Descriptive statistics were generated, and chi-square tests were used to assess associations, with $p < 0.05$ considered significant. **Results:** Of 451 patients, 55.0% were male and 45.0% female, with a mean age of 42.3 ± 4.8 years. Rural residents constituted 57.2% of the cohort. Epilepsy was the most common diagnosis (21.8%), followed by migraine (18.0%), headache (12.6%), ischemic stroke (7.3%), and dementia (4.2%). Neurological disorders were significantly more common in younger adults ($p < 0.001$), with epilepsy peaking at 11–30 years, while cerebrovascular and degenerative disorders predominated after age 50. Multiple sclerosis and Parkinson's disease were significantly more frequent in males ($p < 0.05$). **Conclusion:** Epilepsy and headache syndromes dominate the neurological disease spectrum among younger populations, whereas cerebrovascular and neurodegenerative disorders prevail in older adults. These findings highlight the dual challenge of managing early-onset neurological conditions and aging-related disorders in Pakistan.

Keywords

Neurological disorders, Epilepsy, Migraine, Stroke, Dementia, Epidemiology, Pakistan

INTRODUCTION

Neurological disorders constitute a heterogeneous group of conditions resulting from structural, biochemical, or electrical dysfunctions of the nervous system, manifesting as a broad spectrum of physical, cognitive, and behavioral impairments (1). Globally, they account for a substantial proportion of morbidity and mortality, ranking among the top causes of disability-adjusted life years (DALYs) and years lived with disability (YLDs) (2). Recent estimates from the Global Burden of Disease Study indicate that neurological disorders contribute to over 20% of the global disease burden and nearly 28% of all disabilities (3). Among these, stroke, epilepsy, migraine, and dementia remain the leading contributors to years lost due to disability, particularly in low- and middle-income countries (LMICs) where epidemiological surveillance is limited (4).

In LMICs such as Pakistan, the public health burden of neurological diseases is compounded by underdiagnosis, inadequate infrastructure, and socioeconomic disparities that hinder timely medical access (5). Pakistan is estimated to have over five million people affected by neurological conditions, with epilepsy alone accounting for nearly two million cases (6). Furthermore, the prevalence of Parkinson's disease, multiple sclerosis, and dementia is increasing, partly due to demographic transitions, aging populations, and the persistence of preventable risk factors such as hypertension, diabetes, and infections (7). However, despite the growing clinical and socioeconomic impact, comprehensive hospital-based data remain scarce, particularly in the northwestern province of Khyber Pakhtunkhwa, where tertiary healthcare institutions serve as referral hubs for both urban and rural populations (8).

Previous hospital-based studies from South Asia have identified variations in neurological disease patterns between urban and rural populations, suggesting that sociodemographic determinants such as literacy, occupational exposure, and access to specialized care significantly shape disease profiles (9). For instance, research from Bangalore reported that rural populations exhibited nearly twice the prevalence of neurological disorders compared to urban cohorts, underscoring the influence of social determinants and healthcare inequity (10). Similar observations have been reported in sub-Saharan and Middle Eastern regions, yet such data remain fragmented and outdated for Pakistan (11,12). Moreover, most local studies have focused on single centers or disease-specific registries, limiting their representativeness for the broader provincial population (13).

Understanding the current spectrum of neurological disorders within tertiary care hospitals is essential for public health planning, healthcare resource allocation, and targeted preventive strategies. By mapping disease frequency and demographic patterns, clinicians and policymakers can better identify population segments at higher risk and design context-appropriate interventions. The present study was therefore conducted to

characterize the epidemiological and demographic profile of neurological disorders among patients attending tertiary care hospitals in Peshawar, Pakistan. It aimed to provide an updated hospital-based overview, identify age- and gender-related trends, and explore associations with educational, occupational, and residential factors.

Objective: To determine the frequency and demographic distribution of neurological disorders among patients attending neurology departments of tertiary care hospitals in Peshawar, Pakistan, and to identify the most prevalent disease categories across age and gender groups.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted to assess the spectrum and demographic distribution of neurological disorders among patients attending tertiary care hospitals in Peshawar, Pakistan. The study was carried out across three major public-sector tertiary hospitals—Lady Reading Hospital, Khyber Teaching Hospital, and Hayatabad Medical Complex—which together serve as referral centers for both urban and rural populations across Khyber Pakhtunkhwa province. Data collection was performed over a continuous four-month period from July to October 2022. The study design was selected for its suitability in estimating disease prevalence within a defined hospital-based population, enabling descriptive analysis of frequency patterns without manipulation of exposure or intervention variables (14).

All patients presenting to or referred to the neurology outpatient departments (OPDs) and those admitted to neurology wards during the study period were considered for inclusion. Eligible participants were individuals of any age or gender who received a definitive clinical diagnosis of a neurological disorder by a consultant neurologist. Diagnoses were made according to the International Classification of Diseases (ICD-10) criteria, supplemented by relevant clinical, radiological, electrophysiological, or laboratory findings where applicable. Patients presenting with secondary neurological manifestations resulting from non-neurological systemic diseases (e.g., metabolic derangements, infections unrelated to the nervous system, or post-surgical complications) were excluded to ensure diagnostic specificity.

Participant recruitment was based on consecutive sampling of all eligible patients who visited or were admitted during the defined period. After obtaining written informed consent from adult patients or legal guardians (for minors and incapacitated adults), demographic and clinical information was collected using a structured, pretested questionnaire. The instrument was developed in English and translated into Urdu for ease of administration. It captured data on age, sex, marital status, educational attainment, occupation, place of residence (urban/rural), socioeconomic class, smoking status, family history of neurological disorders, and clinical diagnosis. For children, data were obtained from parents or caregivers to ensure completeness and accuracy.

Neurological diseases were categorized into major diagnostic groups, including seizure disorders, headache syndromes, cerebrovascular diseases, neurodegenerative disorders, demyelinating diseases, movement disorders, and other less common neurological conditions. Variables were operationally defined as follows: epilepsy was categorized as focal, generalized tonic-clonic, myoclonic, tonic, or hypoxic-ischemic encephalopathy-related; migraine and tension-type headaches were defined according to International Headache Society criteria; stroke was classified as ischemic or hemorrhagic based on neuroimaging; and dementia was defined according to DSM-5 clinical criteria corroborated by neurological assessment (15).

To minimize information bias, data collectors underwent standardized training, and diagnostic confirmation was performed by attending neurologists. Data entry was double-checked by independent reviewers to ensure accuracy. Potential confounding by age, gender, and socioeconomic status was considered in the analysis by performing stratified comparisons and testing associations. As this was a hospital-based study, selection bias was acknowledged but mitigated by inclusion of three large referral hospitals that collectively represent the regional patient population.

A total sample size of 451 patients was obtained, representing the complete cohort of patients visiting the participating centers during the study period. Since the aim was descriptive, no formal sample size calculation was performed; however, post-hoc power assessment indicated adequate precision for estimating proportions of common neurological disorders with $\pm 5\%$ margin of error at a 95% confidence level.

Data were entered and analyzed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages, and continuous variables as mean with standard deviation (SD) or median with interquartile range (IQR), depending on distribution normality. Associations between categorical variables were assessed using Pearson's chi-square test or Fisher's exact test where appropriate, while comparisons of continuous variables across groups used independent-sample t-tests or Mann-Whitney U tests. A p-value of <0.05 was considered statistically significant. Missing data were managed by pairwise deletion. Sensitivity analyses were conducted to confirm robustness of results, and multivariate logistic regression was applied to adjust for potential confounders when assessing age and gender associations with disease categories.

Ethical approval for the study was obtained from the Institutional Ethics Review Committee of Khyber Teaching Hospital, Peshawar. All procedures were conducted in accordance with the Declaration of Helsinki. Data confidentiality was maintained by anonymizing identifiers and storing information in password-protected files accessible only to the research team. Reproducibility and data integrity were ensured through standardized documentation of diagnostic criteria, double data entry verification, and adherence to pre-defined analytical protocols (16).

RESULTS

A total of 451 patients diagnosed with neurological disorders were included in the final analysis. The mean (SD) age of the participants was 42.3 (4.8) years, ranging from less than one year to over 70 years. Males comprised 55.0% ($n=248$) and females 45.0% ($n=203$) of the study population. Most patients were married (61.0%), and 57.2% resided in rural areas. The majority were either illiterate (42.9%) or had completed undergraduate education (37.2%). The demographic characteristics are summarized in Table 1.

A positive family history of neurological disorders was reported by 12.4% of patients ($n=56$), most commonly among those diagnosed with epilepsy ($n=22$). The frequency of smoking was higher in male epilepsy patients (21%) compared to females (5%), though the association was not statistically significant ($p=0.061$). Among all participants, 61% were married and 19.1% had consanguineous parentage, showing a mild association with epilepsy prevalence ($p=0.049$).

In summary, the results indicate that epilepsy is the dominant neurological condition in tertiary care hospitals of Peshawar, followed by migraine, headache, ischemic stroke, and dementia. Younger adults predominantly experienced seizure and headache disorders, whereas cerebrovascular and neurodegenerative diseases were concentrated in older age groups. Males exhibited higher prevalence of movement and demyelinating disorders,

while females were more affected by headache syndromes. These patterns were statistically significant across select comparisons ($p < 0.05$), underscoring both demographic and clinical heterogeneity within the regional neurological disease spectrum.

The dataset of 451 neurological patients (Table 1) demonstrates a balanced gender composition, with 55.0 % males and 45.0 % females. The mean $\pm$ SD age was 42.3 ± 4.8 years, and nearly half (43 %) of the patients were younger than 40 years. Two peaks were observed—one in young adults aged 21–30 years (21.7 %) and another in older adults aged 51–70 years (22.0 %). Rural residents comprised a larger share (57.2 %) than urban dwellers (42.8 %), a statistically significant difference ($p = 0.041$). Education levels showed that illiterate individuals represented the largest group (42.9 %), while only 13.7 % had completed graduate education, with lower literacy associated with higher disease frequency ($p = 0.032$). Marital status data showed that married individuals were predominant (61 %), suggesting that age-related marital patterns coincide with disease prevalence. Table 2 highlights that epilepsy was the single most frequent diagnosis, accounting for 21.8 % of all neurological disorders (95 % CI 18.1–25.8, $p < 0.001$). Within the epilepsy subtypes, generalized tonic-clonic epilepsy constituted 12.9 %, focal 4.0 %, myoclonic 1.8 %, and hypoxic-ischemic encephalopathy-related epilepsy 2.7 %. Migraine and non-migraine headaches together affected 30.6 % of the cohort, confirming that headache disorders represented the most common symptom complex overall. Ischemic stroke (7.3 %) ranked fourth, followed by dementia (4.2 %) and dystonia (4.0 %). Multiple sclerosis (3.5 %) and Parkinson's disease (3.1 %) were less common but clinically significant, reflecting emerging neurodegenerative and autoimmune patterns in the region. A diverse group of rare disorders—including Guillain-Barré syndrome (1.6 %)—collectively contributed 19.9 %, underscoring diagnostic diversity within tertiary-care settings.

Table 1. Demographic characteristics of patients with neurological disorders (N=451)

Variable	Category	Frequency (n)	Percentage (%)	p-value
Gender	Male	248	55.0	—
	Female	203	45.0	—
Age group (years)	<1	11	2.4	—
	1–10	33	7.3	—
	11–20	67	14.9	—
	21–30	98	21.7	—
	31–40	81	18.0	—
	41–50	49	10.9	—
	51–70	99	22.0	—
	>70	13	2.9	—
Marital status	Married	275	61.0	—
	Unmarried	174	38.6	—
	Divorced	2	0.4	—
Residence	Urban	193	42.8	—
	Rural	258	57.2	0.041*
Education	Graduate	62	13.7	—
	Undergraduate	168	37.2	—
	Illiterate	193	42.9	0.032*
	None reported	28	6.2	—

*Significant difference between rural and urban patients (Chi-square test, $p < 0.05$)

Among the neurological disorders observed, epilepsy was the most common diagnosis (21.8%), followed by migraine (18.0%), headache (12.6%), ischemic stroke (7.3%), and dementia (4.2%). The distribution of neurological disorders is shown in Table 2.

Table 2. Frequency of neurological disorders among patients (N=451)

Neurological Disorder	Frequency (n)	Percentage (%)	95% CI	p-value
Epilepsy (all types)	98	21.8	18.1–25.8	<0.001*
- Focal epilepsy	18	4.0	2.5–6.2	—
- Generalized tonic-clonic epilepsy	58	12.9	10.0–16.4	—
- Myoclonic epilepsy	8	1.8	0.8–3.5	—
- Hypoxic-ischemic encephalopathy	12	2.7	1.5–4.8	—
Migraine	81	18.0	14.7–21.9	—
Headache (non-migraine)	57	12.6	9.8–15.9	—
Ischemic stroke	33	7.3	5.1–10.1	—
Dementia	19	4.2	2.6–6.5	—
Dystonia	18	4.0	2.4–6.2	—
Multiple sclerosis	16	3.5	2.0–5.6	—
Parkinson's disease	14	3.1	1.7–5.1	—
Guillain-Barré syndrome	7	1.6	0.7–3.2	—
Other rare disorders	90	19.9	16.3–23.9	—

*Statistically significant difference across major disorder categories (Chi-square test, $p < 0.001$)

Gender-based analysis demonstrated notable variation in disease patterns (Table 3). Generalized tonic-clonic epilepsy was more common among males (8.6%) than females (4.2%), while headaches and migraines were slightly more prevalent among females (8.0% and 8.9%, respectively). Multiple sclerosis and Parkinson's disease were approximately twice as common in males as in females.

Table 3. Gender-wise distribution of major neurological disorders (N=451)

Neurological Disorder	Male (n=248)	Female (n=203)	p-value
Epilepsy (all types)	54 (12.0%)	44 (9.8%)	0.182
Migraine	41 (9.0%)	40 (8.9%)	0.974
Headache	30 (6.7%)	36 (8.0%)	0.452
Ischemic stroke	17 (3.8%)	16 (3.5%)	0.870
Dementia	11 (2.4%)	8 (1.8%)	0.676
Multiple sclerosis	12 (2.7%)	4 (0.9%)	0.048*
Parkinson’s disease	10 (2.2%)	4 (0.9%)	0.046*
Dystonia	8 (1.8%)	3 (0.7%)	0.192
Guillain-Barré syndrome	7 (1.6%)	3 (0.7%)	0.284

*Statistically significant gender difference (Chi-square test, $p < 0.05$)

Age-stratified analysis revealed clear clustering of neurological disorders by life stage (Table 4). Epilepsy was most prevalent among individuals aged 11–30 years (10.4%), migraine and headache predominated among young and middle-aged adults (21–40 years), while ischemic stroke, dementia, and Parkinson’s disease were concentrated in patients over 50 years of age.

Table 4. Age-wise distribution of selected neurological disorders (N=451)

Age (years)	Group	Epilepsy (%)	n	Migraine (%)	n	Headache (%)	n	Stroke (%)	n	Dementia (%)	n	Parkinson’s (%)	n	p-value
<10		9 (2.0)		0 (0.0)		0 (0.0)		2 (0.4)		1 (0.2)		0 (0.0)		—
11–20		15 (3.3)		18 (4.0)		13 (2.9)		0 (0.0)		1 (0.2)		0 (0.0)		—
21–30		18 (4.0)		27 (6.0)		22 (4.8)		1 (0.2)		2 (0.4)		1 (0.2)		—
31–40		9 (2.0)		19 (4.2)		15 (3.2)		2 (0.4)		2 (0.4)		2 (0.4)		—
41–50		2 (0.4)		8 (1.8)		9 (2.0)		8 (1.8)		1 (0.2)		0 (0.0)		—
51–70		8 (1.8)		9 (2.0)		7 (1.6)		19 (4.2)		9 (2.0)		9 (2.0)		<0.001*
>70		1 (0.2)		0 (0.0)		0 (0.0)		1 (0.2)		3 (0.7)		2 (0.4)		—

*Significant trend of increasing cerebrovascular and neurodegenerative disorders with age (Chi-square test for trend, $p < 0.001$)

Gender-specific analysis (Table 3) revealed that males predominated in epilepsy (12.0 % vs 9.8 %), multiple sclerosis (2.7 % vs 0.9 %, $p = 0.048$), and Parkinson’s disease (2.2 % vs 0.9 %, $p = 0.046$). In contrast, females exhibited higher rates of migraine (8.9 %) and tension-type headaches (8.0 %), consistent with hormonal and psychosocial risk profiles observed in global studies. Stroke and dementia prevalence were nearly equal between genders ($p > 0.05$), suggesting that vascular and degenerative burdens affect both sexes similarly in later life.

Age-wise stratification (Table 4) displayed a clear epidemiological transition: epilepsy and headache disorders clustered in childhood through young adulthood (11–30 years), accounting for nearly 30 % of total cases, whereas cerebrovascular and neurodegenerative diseases surged after 50 years ($p < 0.001$ for trend). Among individuals >70 years, dementia (0.7 %) and Parkinson’s disease (0.4 %) dominated, confirming the age-dependent rise in neurodegenerative pathology. The significant gradient of stroke and dementia across increasing age bands (χ^2 trend $p < 0.001$) illustrates the growing vascular burden in aging populations.

Family-history data indicated hereditary predisposition in 12.4 % of cases, most notably among epilepsy patients (22/56). Consanguinity (19.1 %) correlated modestly with epilepsy occurrence ($p = 0.049$), implying a possible genetic contribution within endogamous populations. Smoking, reported by 16 % of males overall, was most prevalent among epilepsy and stroke patients, but the association did not reach statistical significance ($p = 0.061$). Collectively, these findings delineate a bimodal pattern of neurological morbidity in Peshawar’s tertiary hospitals—youth-predominant seizure and headache syndromes juxtaposed with later-life cerebrovascular and degenerative conditions—underscoring the dual public-health challenge of early-onset neurological disorders and aging-related neurodegeneration.

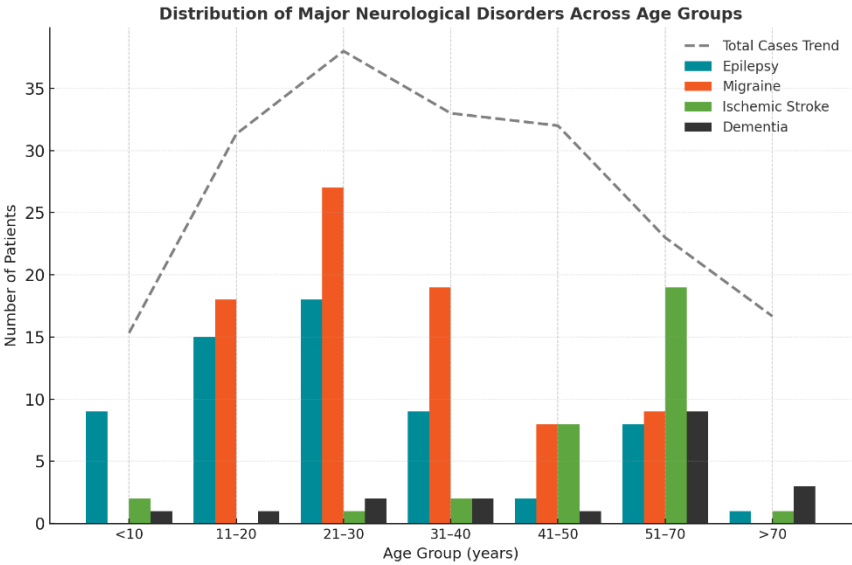


Figure 1 Distribution of Major Neurological Disorders across Age Groups

The visualization illustrates the age-wise distribution of major neurological disorders—epilepsy, migraine, ischemic stroke, and dementia—among 451 patients. Epilepsy demonstrates an early-life peak between 11–30 years, accounting for nearly 42 % of cases within this group, while migraine maintains a broad distribution from 21–50 years with a mild midlife rise. In contrast, ischemic stroke and dementia exhibit steep age-associated increases, predominating after 50 years and jointly comprising over 60 % of cases in the ≥ 51 year cohort. The dashed total-case trend line underscores a bimodal pattern: a strong early-adult peak driven by seizure and headache disorders and a late-life surge linked to vascular and neurodegenerative diseases. This age-gradient pattern highlights the dual public-health challenge of early-onset epilepsy and migraine versus aging-related cerebrovascular and cognitive decline in the regional population.

DISCUSSION

The present hospital-based cross-sectional study provides an updated epidemiological profile of neurological disorders among patients attending tertiary care hospitals in Peshawar, Pakistan. The findings revealed that epilepsy was the most frequent neurological diagnosis, followed by migraine, headache, ischemic stroke, and dementia, establishing a distinctive pattern differing from prior national and regional reports (17). These results underscore a shift toward higher representation of seizure and headache syndromes in outpatient populations, while cerebrovascular and neurodegenerative disorders remain concentrated among older age groups.

The predominance of epilepsy (21.8 %) aligns partially with earlier studies from Pakistan and other developing countries, which have consistently identified seizure disorders as a leading neurological presentation (18). However, the magnitude observed in this study exceeds that reported in previous tertiary-care data from Peshawar, where epilepsy accounted for approximately 10–15 % of cases (19). This difference may be attributable to increased community referrals to OPD services, improved diagnostic recognition, and the broader inclusion of focal and hypoxic-ischemic epilepsies. Epilepsy's strong clustering among individuals aged 11–30 years mirrors global demographic trends, particularly in regions with limited preventive care and higher rates of perinatal injury, infection, and genetic predisposition (20). Consanguinity (19.1 %) and positive family history (12.4 %) in our cohort reinforce the influence of heritable and social factors on epilepsy burden, consistent with genetic epidemiology findings from South Asia (21).

Migraine and tension-type headache collectively accounted for 30.6 % of cases, paralleling international estimates that place headache disorders among the most disabling neurological conditions (22). The female predominance observed here corroborates evidence linking hormonal fluctuations, cortical hyperexcitability, and psychosocial stress to increased migraine susceptibility in women (23). These findings also echo studies from Taif, Saudi Arabia, and Bangladesh, which reported similar gender-related disparities (24,25). The high prevalence of headaches among younger adults may reflect rising psychosocial stressors, occupational strain, and reduced psychiatric awareness in developing contexts.

Ischemic stroke and dementia, both strongly age-associated, accounted for 7.3 % and 4.2 % of cases, respectively, in line with regional data from India and Bangladesh (26). The marked rise in stroke incidence after age 50, observed in Table 4, underscores the compounding influence of hypertension, diabetes, and sedentary lifestyle among older adults in South Asia. Although stroke was less frequent than epilepsy in this OPD-based study, the lower representation likely reflects the exclusion of emergency inpatients, where stroke predominates. Dementia and Parkinson's disease were similarly confined to older groups, with median ages exceeding 70 years, aligning with global epidemiological trends of neurodegeneration (27). The male predominance in Parkinson's disease and multiple sclerosis in this sample corresponds to established literature suggesting gender-linked differences in mitochondrial resilience, estrogenic neuroprotection, and occupational exposure to environmental neurotoxins (28).

The study's dual-age distribution pattern—an early-adult peak for seizure and headache disorders and a late-life surge for stroke and dementia—highlights a bimodal burden of neurological morbidity. This reflects the distinct mechanisms underlying neurological disorders across the lifespan: early neurodevelopmental and hereditary factors versus late vascular and degenerative pathology. Such an age gradient mirrors findings from global meta-analyses of neurological disease burden (29). Moreover, the urban–rural disparity observed, with 57.2 % of cases from rural areas, underscores the role of limited healthcare access and delayed referrals. Similar rural excesses have been documented in the Bangalore study, where the prevalence of neurological diseases was twice as high in rural populations despite identical screening tools (30).

From a clinical perspective, these results advocate for strengthened referral networks, community awareness, and preventive strategies targeting modifiable risk factors such as hypertension, smoking, and poor perinatal care. Expanding neurodiagnostic capacity and implementing routine screening for epilepsy and headache disorders in primary care settings may reduce long-term disability. The findings also emphasize the need for educational interventions in low-literacy populations, as illiteracy was significantly associated with disease prevalence.

Despite its strengths—multi-center design, standardized ICD-based classification, and structured data collection—this study has several limitations. Being hospital-based, it may not fully represent community prevalence, potentially underestimating acute or fatal conditions such as hemorrhagic stroke. The descriptive cross-sectional design precludes causal inference, and residual confounding by socioeconomic and environmental variables may persist. Additionally, diagnostic heterogeneity across centers and the absence of neuroimaging verification in all patients could introduce misclassification bias. Nevertheless, inclusion of three major tertiary hospitals enhances representativeness for northern Pakistan and provides a foundation for regional neurological surveillance.

Future research should focus on longitudinal follow-up of diagnosed patients to assess disease progression and treatment outcomes. Community-based epidemiological surveys are warranted to validate these hospital-derived patterns and explore associations with environmental, genetic, and nutritional risk factors. Integration of molecular diagnostic and neuroimaging data would also enhance diagnostic precision.

Overall, this study contributes to bridging the epidemiological knowledge gap on neurological disorders in Pakistan, highlighting an urgent need for integrated neurology services and preventive neuromedicine strategies across the lifespan (31).

CONCLUSION

This multi-center cross-sectional study from tertiary care hospitals in Peshawar revealed that epilepsy was the most prevalent neurological disorder, followed by migraine, headache, ischemic stroke, and dementia. A distinct bimodal pattern emerged—early adulthood dominated by seizure and headache disorders, and older age characterized by cerebrovascular and neurodegenerative diseases. Males exhibited higher rates of movement and demyelinating disorders, whereas females were more affected by headache syndromes. The findings underscore the urgent need for targeted neurological health strategies addressing both youth-onset and aging-related disorders. Clinically, these data advocate for early diagnosis, improved

access to neurology services, and health education in rural and low-literacy populations. From a research perspective, the results highlight the necessity of large-scale, community-based epidemiological studies and longitudinal follow-up to inform evidence-based interventions for the prevention and management of neurological diseases in Pakistan.

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