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Epidemiological Analysis of Epilepsy Prevalence in the Pashtun Population: A Comparative Study in Khyber Pakhtunkhwa, Pakistan

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Abstract: Epilepsy is a significant neurological disorder with a high prevalence in low- and middle-income regions, including Khyber Pakhtunkhwa (KP), Pakistan. Despite advancements over the past two decades, limited epidemiological data is available regarding the clinical and demographic features of epilepsy in this region. Socioeconomic barriers and cultural factors further impair the treatment gap. This study aimed to investigate the prevalence and clinical characteristics of epilepsy in the Pashtun population of KP, focusing on factors such as age, gender, parental consanguinity, and family history. A cross-sectional study was conducted at the Department of Neurology, Lady Reading Hospital (LRH), Peshawar. Data was collected through structured interviews and questionnaires from epileptic patients admitted to the hospital. The study analyzed demographic and clinical factors, including disease onset, age, gender, parental consanguinity, and family history. Among the surveyed population, males were found to be more affected by epilepsy compared to females. The highest prevalence was observed in individuals aged 11 to 20 years. Many patients reported parental consanguinity, indicating a possible genetic predisposition. Additionally, a family history of epilepsy was frequently observed, further emphasizing the hereditary nature of the disorder in the study population. The study highlights key epidemiological patterns of epilepsy in KP, with a higher prevalence among males and adolescents. The outcomes underscore the importance of addressing genetic factors and implementing targeted public health interventions, including early diagnosis and community education, to reduce the treatment gap and improve regional patient outcomes.

Keywords: Epilepsy, prevalence, Khyber Pakhtunkhwa, gender, age groups, parental consanguinity, family history, clinical features, neurological disorder.

1. Introduction

Epilepsy is one of the most prevalent neurological disorders, affecting individuals across all ages, races, socioeconomic classes, and geographic regions. It is characterized by recurrent seizures resulting from abnormal neural activity, which disrupts the balance between neuronal inhibition and excitation [1]. These seizures, often presenting as transient episodes of altered consciousness and behavior, stem from disturbances in electrical communication between neurons [2]. The classification of seizures is based on their onset, degree of awareness, and symptoms, broadly categorized into focal and generalized

epilepsy [3]. A diagnosis of epilepsy requires at least two unprovoked seizures occurring more than 24 hours apart, with a prevalence of 7.6 per 1,000 individuals worldwide, impacting 50–65 million people [4]. The incidence is higher in children under five and adults over 65 years old, with 30–50% of cases progressing to treatment-resistant epilepsy [5]. In Pakistan, epilepsy prevalence is approximately 9.99 per 1,000, with higher rates in rural populations and among younger individuals [6]. Genetic factors are implicated in 70–80% of cases, including mutations in ion channel genes and chromosomal abnormalities, which are major contributors to idiopathic epilepsies [7] Epilepsy results from a combination of genetic and acquired factors, with genetic predisposition playing a predominant role. Approximately 40–50% of epilepsy cases are attributed to genetic causes, which include single-gene mutations, gene families, and chromosomal abnormalities [8]. Genetic epilepsies are classified based on inheritance patterns into three main categories: Mendelian Disorders: These are single-gene disorders with clear inheritance patterns, such as autosomal dominant nocturnal frontal lobe epilepsy and benign familial neonatal convulsions. While Mendelian epilepsies are rare, they account for about 1% of cases and are often associated with structural or metabolic abnormalities, like those seen in tuberous sclerosis. Complex Disorders: These involve polygenic influences combined with environmental factors, as observed in childhood absence epilepsy, juvenile myoclonic epilepsy (JME), and benign childhood epilepsy with centrotemporal spikes. Chromosomal Abnormalities: Severe cytogenetic anomalies, including trisomy 12p and Down syndrome, are frequently linked to epilepsy phenotypes. Epilepsy is also a phenotype in over 200 Mendelian disorders, reflecting its genetic complexity. While a small subset of epilepsies is considered "pure" genetic syndromes, most cases exhibit a multifactorial etiology involving genetic predisposition and external influences [9]. Epilepsy is one of the most prevalent neurological disorders, affecting over 65 million individuals globally, with an annual incidence of 50.4–81.7 per 100,000 people. In high-income countries, the prevalence is approximately 700 per 100,000, while the incidence is around 50 per 100,000 annually. In contrast, developing nations report higher prevalence and incidence rates due to socioeconomic and healthcare disparities. For instance, China has a prevalence of 2.89 per 1,000, with 0.4 million new cases annually, while India reports a prevalence of 3.0–11.9 per 1,000 and an incidence of 0.2–0.6 per 1,000 annually. In Pakistan, epilepsy affects 9.99 per 1,000 people, with higher rates in rural (14.8/1,000) compared to urban areas (7.4/1,000). Approximately 2 million individuals in Pakistan have epilepsy, with the majority being under 30 years old. The prevalence is especially high in Khyber Pakhtunkhwa (KP), underscoring the need for localized research to understand the epidemiology and risk factors of epilepsy in this region [10]. The present study aims to provide epidemiological insights into epilepsy in KP, Pakistan. It seeks to quantify prevalence and incidence rates, identify genetic, environmental, and social risk factors, and explore cultural barriers to diagnosis and treatment. By addressing gaps in healthcare access and highlighting unmet needs, this research offers evidence-based recommendations to improve epilepsy management, reduce stigma, and enhance healthcare policies. Moreover, the outcomes contribute to global epilepsy research, enabling comparative analyses and fostering a deeper understanding of the condition across diverse cultural contexts. [11].

2. Methodology

Study Setting

This study was conducted at the Institute of Biotechnology and Genetic Engineering (IBGE), University of Agriculture, Peshawar, to statistically evaluate the prevalence of epilepsy across various regions of Khyber Pakhtunkhwa (KP), Pakistan. Patient data was obtained from the Lady Reading Hospital (LRH) Neurology Department, Peshawar.

Data Sampling

The study utilized data from a cohort of epilepsy patients, collected through interviews with the patients or their family members. Sampling was stratified based on age and gender, and relevant clinical features of the patients were systematically recorded.

Data Collection and Ethical Considerations

Data collection spanned nine months, from January to September 2022, through periodic visits to the Neurology Department at LRH, Peshawar. Informed written consent was obtained from all participants or their legal guardians. Ethical clearance for the study was granted by the Ethical Committee of the Institute of Biotechnology and Genetic Engineering (IBGE), University of Agriculture, Peshawar, and the Human Resource Department (HRD) of LRH.

Experimental Design

To determine the prevalence of epilepsy in the regions of Khyber Pakhtunkhwa (KP), Pakistan, a detailed survey was conducted at Lady Reading Hospital (LRH), Peshawar. All patients diagnosed with epilepsy were included in the study. A structured questionnaire was administered, collecting information on patient name, age, gender, ethnicity, disease onset, family history, clinical diagnosis, and medications used.

Statistical analysis

The statistical analysis was performed using the SPSS 23.0 version. Chi-square tests were assessed to determine the associations between categorical variables (e.g., gender and prevalence), while t-tests or ANOVA were utilized to compare means across groups (e.g., age distributions). Logistic regression was employed to evaluate risk factors contributing to epilepsy prevalence

3. Results

Gender wise distribution

The study analyzed 86 individuals diagnosed with epilepsy. Among these, 49 patients were male (57%) and 37 were female (43%), indicating a higher prevalence of epilepsy in males. The observed gender disparity could be attributed to differences in the incidence of prevalent risk factors, as well as sociocultural practices in certain regions, where women may be less likely to disclose or seek treatment for the condition. The overall distribution is shown in **table 1.**

Table 1: Gender Distribution of Epilepsy Patients

Gender	Frequency (n=86)	Percentage (%)
Male	49	57%
Female	37	43%
Total	86	100%

Age-wise distribution

Out of the total 86 patients, the majority (35%) were aged 11–20 years, followed by those aged 1–10 years (30%). These outcomes suggest a significant association between epilepsy incidence and younger age groups, indicating that epilepsy is more prevalent in

early life. Table 2 presents the age-wise prevalence of epilepsy patients in the study population.

Table 2: Age-wise distribution of Epilepsy in the Study Population

Age (Years)	Male (%)	Female (%)	Total (%)
1–10	13 (15%)	13 (15%)	26 (30%)
11–20	15 (17%)	15 (17%)	30 (35%)
21–30	9 (10%)	4 (4%)	13 (15%)
31–40	6 (7%)	1 (1.1%)	7 (8%)
41–50	3 (3%)	3 (3%)	6 (7%)
Above 50	3 (3%)	1 (1.1%)	4 (4%)

Clinical Features of Epilepsy (n = 86)

The clinical diagnosis revealed various features exhibited by epilepsy patients, including seizures, tongue biting, foaming at the mouth, urinary incontinence, body stiffness, body twisting, and loss of consciousness. The most frequently reported symptoms were seizures (78%), followed by tongue biting (42%), foaming at the mouth (21%), urinary incontinence (20%), loss of consciousness (18%), body stiffness (16%), and body twisting (16%). Table 3 summarizes the clinical features observed in the study population.

Table 3: Clinical Features of Epilepsy Observed in the Study Population

Sr. No	Symptoms	Male (M)	Female (F)	Total N (%)
1	Seizures	37 (43%)	29 (34%)	66 (78%)
2	Tongue biting	19 (23%)	17 (20%)	36 (42%)
3	Foam from mouth	13 (15%)	5 (6%)	18 (21%)
4	Urinary incontinence	12 (14%)	5 (6%)	17 (20%)
5	Body stiffness	8 (9%)	6 (7%)	14 (16%)
6	Body twisting	8 (9%)	6 (7%)	14 (16%)
7	Loss of consciousness	10 (11%)	6 (7%)	16 (18%)

Note: n = 86; M = Male; F = Female

Parental Consanguinity

The prevalence of family history and parental consanguinity among the studied cohort was 65%, while a family history of epilepsy was reported in 74% of cases. In a study involving 86 epileptic patients, 32 males (37%) and 24 females (28%) were identified as having a history of parental consanguinity. Furthermore, 32 males (37%) and 32 females

(37%) reported a family history of epilepsy. A significant correlation was observed between parental consanguinity and the likelihood of developing epilepsy. Similarly, a family history of the condition emerged as a critical risk factor for its onset. Table 4 illustrates the distribution of parental consanguinity and family history of epilepsy among the study population.

Table 4: Data for Consanguineous Marriages and Family History

Parameter	Gender	Frequency (%)	Total (%)
Parental Consanguinity	Male	32 (37%)	56 (65%)
	Female	24 (28%)	
Family History of Epilepsy	Male	32 (37%)	64 (74%)
	Female	32 (37%)	

4. Discussion

Assessing disease prevalence through medical records is a common approach, yet it has inherent limitations. One key challenge is determining the demographic served by medical institutions, particularly in regions with limited healthcare access. Additionally, conditions like epilepsy, which often carry social stigma, may be underreported, especially in communities with inadequate medical coverage. Our study observed a higher prevalence of epilepsy among male patients, a finding consistent with the results of Khan et al. (2011), who reported higher epilepsy rates among men in urban areas. However, our results differ from those of Ghanizadeh et al. (2006), who found a higher prevalence of epilepsy among Iranian women, highlighting the role of sociocultural and geographical factors in influencing disease patterns. The highest prevalence of epilepsy was observed among individuals aged 11 to 20 years in our study. This finding aligns with prior studies conducted in Pakistan and India, which reported similar age-related trends (Aziz et al., 1997; Mani et al., 1998) Notably, previous research has shown that approximately 50% of epilepsy cases begin in childhood or adolescence, with pediatric populations experiencing higher prevalence rates (Aydin, 2002). Our study also identified a significant association between epilepsy and consanguineous marriages, as well as a positive family history of the condition. Consistent with Luengo et al. (2001), individuals with a genetic predisposition were found to have a 2.5-fold increased likelihood of developing epilepsy. These outcomes underscore the importance of genetic factors in the etiology of epilepsy, particularly in populations with high rates of consanguinity. Although epilepsy is a prevalent chronic neurological disorder across various age groups, there remains a paucity of epidemiological data, especially from rural areas of Khyber Pakhtunkhwa (KPK), Pakistan. Reports indicate a crude prevalence rate of 9.98 per 1,000 individuals in Pakistan, with 74% of cases occurring in younger populations (Wong et al., 2003). Key risk factors include head trauma, central nervous system infections, febrile seizures, mental retardation, and cerebral palsy (Aydin, 2002). Raising awareness about epilepsy and its management is critical, particularly in remote and underserved regions. Enhanced public knowledge and targeted education for healthcare professionals can improve disease recognition, reduce stigma, and promote timely interventions. This, in turn, can enhance the quality of life for patients and reduce the overall disease burden. Numerous studies have explored

perceptions of epilepsy in both developed and developing nations (Aziz et al., 1997; Iivanainen et al., 1980) However, variations in population characteristics, research methodologies, and survey designs limit the comparability of these outcomes. Future research should adopt standardized methods to provide more comprehensive insights into epilepsy's epidemiology and its social implications (Radhakrishnan et al., 2000).

Limitations and Strengths of the Study

This study's primary limitation is its hospital-based design, which restricts its ability to represent the broader societal prevalence of epilepsy. As the data were collected from a specific hospital population, the outcomes may not fully capture cases from rural or underserved areas. However, a notable strength of this research is its potential to serve as a foundation for future community-based investigations. Such studies could provide a more comprehensive understanding of the incidence of epilepsy and the associated social stigma.

5. Conclusions

The study revealed a higher prevalence of epilepsy among male patients (57%), with the highest incidence observed in the 11 to 20-year age group. Key contributing factors included consanguineous marriages and a positive family history of epilepsy. These outcomes highlight the importance of addressing genetic and social factors to improve epilepsy management and awareness.

Conflicts of Interest

The authors declare no conflicts of interest.

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