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Clinical characteristics of pediatric epilepsy in Palestine: a cross-sectional study

Reem Sawafta[1], Zaher Nazzal[1], Motee Ashhab[2], Sofian Nassar[1], Khitam Salahat[1], Ola Dawabsheh[1] and Ahmed J. Abushama[3*]

Abstract

Background Epilepsy, a prevalent neurological disorder in children, is characterized by recurrent unprovoked seizures and developmental challenges. Although pediatric epilepsy is well-studied globally, research in Palestine is limited, which affects targeted healthcare interventions. Furthermore, socioeconomic barriers and limited resources make it difficult to manage epilepsy locally. This study addresses the clinical, diagnostic, and therapeutic aspects of pediatric epilepsy in Palestine to inform evidence-based healthcare planning and improve outcomes for affected children.

Methods A retrospective cross-sectional study was conducted between December 2023 and October 2024, analyzing medical records of 411 pediatric epilepsy patients (aged 2 months to 18 years) diagnosed between 2019 and 2024 at two major pediatric neurology clinics in the West Bank. The data on demographics, seizure types, diagnostic tools, etiology, comorbidities, and treatment approaches were collected retrospectively. The statistical analysis was conducted using IBM SPSS version 24, which employed both descriptive and analytical statistics to identify associations.

Results Of the 411 patients, 67.2% were male, and 38.3% were school-age children at the time of seizure onset. Focal seizures were the most common type (62.8%). Among epilepsy syndromes, self-limited epilepsy with centrotemporal spikes (SeLECTs) was the most frequently identified (10.9%). The etiology was unknown in 53.8% of cases; genetic and structural causes were identified in 7.3% and 13.6%, respectively. Monotherapy was used in 62% of patients, including 71.6% of those without comorbidities. A statistically significant association was found between the number of antiseizure medications (ASMs) and the presence of comorbidities ($p=0.001$), with patients without comorbidities more likely to receive monotherapy. Significant correlations were also identified between seizure type and age of onset ($p=0.000$), etiology ($p=0.001$), and type of comorbidities (excluding mood disorders). Drug-resistant epilepsy affected 3.4% of patients and was significantly associated with younger age at seizure onset ($p=0.042$), cognitive and developmental comorbidities ($p<0.05$), and genetic etiology ($p=0.02$). Only 1% of patients received surgical intervention, and none were treated with ketogenic diets.

Conclusion This study focused on the clinical characteristics of pediatric epilepsy and highlighted the challenges associated with the availability of treatment modalities, advanced diagnostic tools such as genetic testing, and the limited use of dietary and surgical interventions in Palestine.

*Correspondence:
Ahmed J. Abushama
Ahmed.abushama@kingstonHSC.ca

Full list of author information is available at the end of the article

Keywords Pediatric epilepsy, Palestine, Seizure types, Anti-seizure medications, Diagnostic challenges, Comorbidities

Introduction

Epilepsy is a common neurological disorder that affects many children worldwide. It is defined as a brain disorder characterized by recurrent, unprovoked seizures resulting from abnormal electrical activity in the brain. According to the International League Against Epilepsy (ILAE), epilepsy is clinically defined as a disease of the brain characterized by any of the following conditions: (1) at least two unprovoked seizures occurring more than 24 h apart, (2) one unprovoked seizure and a probability of further seizures similar to the general recurrence risk after two unprovoked seizures (i.e., at least 60%), or (3) diagnosis of an epilepsy syndrome [1]. Epilepsy affects around 50 million people worldwide, with an estimated 10 million of them being children. Pediatric epilepsy (PE) is a unique challenge, not only medically but also socially and emotionally. Children with epilepsy often face developmental delays, cognitive impairments, and psychological distress, disrupting their educational and social experiences. The condition can result in stigma and social isolation, further exacerbating its effects. Early diagnosis and effective treatment are crucial for overcoming these obstacles, improving outcomes, and improving the quality of life for affected children and their families [2–4].

While advances in diagnostic tools like electroencephalography (EEG), neuroimaging, and genetic testing have improved epilepsy management in high-resource settings, resource-constrained areas face significant challenges. Palestine is an example of such a setting, with limited availability of diagnostic technologies, newer anti-seizure medications (ASM), the ketogenic diet, epilepsy surgery workups, and epilepsy surgery itself. The high cost of medications, combined with economic insecurity and political conflict in Palestine, poses significant barriers to caring for these children. Furthermore, cultural stigma surrounding epilepsy often leads to delays in seeking medical advice, resulting in misdiagnosis or delayed management. Furthermore, in resource-limited healthcare systems like Palestine, the burden of PE intensifies due to inadequate infrastructure [5–7].

Despite extensive research on PE in high-income countries, there is an alarming lack of localized data from low-resource settings such as Palestine. Important aspects such as prevalence, age and gender distribution, seizure types, etiology, comorbidities, and treatment outcomes remain underexplored. This knowledge gap impedes the development of evidence-based healthcare interventions and national treatment guidelines tailored to the specific needs of Palestinian children with epilepsy. Policymakers and healthcare providers frequently rely on international studies, which may not adequately address the region's unique cultural, economic, and systemic challenges [8, 9].

Methods

Aim and objectives

The main aim of the study was to investigate the clinical features of PE in Palestine. Specific objectives included exploring pediatric epilepsy's diagnostic practices and treatment methods used in the pediatric neurology clinics involved in the research, examining potential relationships between sociodemographic characteristics and different types of seizures, and analyzing the correlation between the age at which epilepsy onset occurred, the type of seizures experienced, the occurrence of drug-resistant epilepsy (DRE), and the number of ASM used.

Study design and settings

This retrospective, cross-sectional, observational study was conducted among 411 outpatients attending neurology clinics at two specialized centers in the West Bank, Palestine: the Specialized Medical Center in Ramallah and the M Clinic Center in Nablus. The Specialized Medical Center is the oldest and largest center managing pediatric epilepsy in the region, covering the southern and central areas of the West Bank. The M Clinic is the only dedicated pediatric epileptologist service in the country, providing coverage for the northern West Bank.

Data collection took place between December 2023 and October 2024, during which medical records of patients diagnosed with epilepsy between January 2019 and October 2024 were reviewed. This five-year timeframe was selected to ensure the inclusion of recent and relevant data that reflect current clinical practices, diagnostic criteria, and treatment approaches. It also corresponds with updates to international epilepsy classification systems and local improvements in electronic medical documentation, enhancing both the clinical relevance and the quality of the data. Given the limited number of pediatric neurologists and epileptologists in Palestine, all were approached, and those who consented to participate and provided access to their patients' records were included in the study.

A representative map showing the geographic locations of the study centers and their coverage areas is provided as [Additional file 1].

Study population

Inclusion criteria

The study included any pediatric patient with an official diagnosis of epilepsy aged 2 months to 18 years who had been evaluated at pediatric neurology outpatient clinics

within the last 5 years (2019–2024) before the data collection period.

Exclusion criteria

Patients were excluded if they had an alternative diagnosis for their seizures, simple or complex febrile convulsions, or seizures that occurred in association with an acute metabolic or toxic event. Furthermore, patients with neonatal seizures (occurring only in the first month of life), single seizure events, or a single occurrence of status epilepticus were excluded. Patients with incomplete medical records were not eligible for inclusion.

We reviewed the files of patients who met our inclusion criteria. Access to the files was granted following prior approval from the An-Najah National University Institutional Review Boards (Ref: Med. April 2024/14) and clinic personnel.

Sample size

Our study included all accessible, officially diagnosed epilepsy cases under active follow-up over the past five years (2019–2024), totaling 411 participants. To ensure methodological accuracy, we performed a post hoc sample size calculation based on epidemiological standards for prevalence studies. Using the formula $^{*}n^{*} = (Z^2 \times P \times (1 - P))/^{*}d^{*2}$, where $Z = 1.96$ (95% confidence level), P = estimated prevalence, and $^{*}d^{*}$ = margin of error, we determined that a minimum of 386 participants was required to achieve 80% statistical power. Therefore, our sample size of 411 is sufficient to ensure adequate statistical power and enhance the reliability and validity of the study's conclusions.

Research tool

To achieve our research objectives, we constructed a data sheet based on a review of previous studies about this disease [Additional file 2]. This sheet was designed to collect various study variables. It consists of three sections. The first section includes questions about the patient's sociodemographics, such as age, gender, and place of residence. The second section contains clinical data, which includes information such as the patient's age when the seizures began, family medical history, and causative factors, the type of seizure and syndrome according to the ILAE 2017 classification system, diagnostic methods, and ASM used. The third section focuses on surgical intervention, ketogenic diet use, and the outcomes for each. Then we collected data from clinics specializing in the treatment of PE based on the sheet.

Study variables

Our study analyzed independent, dependent, and specific variables. Demographic variables, clinical characteristics of epilepsy, diagnostic characteristics (tools used), and treatment-related variables were all independent variables. While the dependent variable was a seizure-related variable, specifically the type of seizure. Our study included a category of specific variables that were analyzed as both dependent and independent variables, such as comorbidities and DRE.

DRE was defined by the ILAE as the failure of adequate trials of two tolerated, appropriately chosen, and appropriately used antiepileptic drug schedules (whether as monotherapies or in combination) to achieve sustained seizure freedom [10]. A detailed list of the variables can be found in [Additional file 3].

Statistical analysis

The collected data were entered and processed using the Statistical Package for Social Sciences (SPSS) version 24. Descriptive statistics, such as frequency and percentage, were calculated for each categorical dataset. Chi-square tests with a significant level of p-value < 0.05 were used to determine associations between study variables with a confidence interval of 95%.

Results

Sociodemographic characteristics of patients

A total of 411 patients from two of Palestine's six PE treatment facilities were included in the study. There were 276 males and 135 females, and their ages ranged from 2 months to 18 years. Regarding the age of onset of epilepsy, 158 (38%) were school-aged (6–12 years), 85 (20.7%) were preschoolers (3–6 years), and 79 (19.2%) were infants. The average age at onset was 5 years, with a standard deviation of 1.25. The majority of patients (294; 71.5%) were from northern regions; Table 1 contains more information on sociodemographic characteristics.

Seizure types and etiology of epilepsy

As shown in Table 2, the majority of the sample, 221 patients (53.8%), had an unidentified cause of epilepsy. In contrast, 56 patients (13.6%) had symptomatic causes, which included hypoxic-ischemic encephalopathy, meningitis, and neonatal hypoglycemia.

Genetic testing was not routinely performed for all patients in our sample, as it remains selectively available in our setting. Testing was prioritized for patients with DRE, especially those with non-lesional imaging, syndromic features, or additional neurodevelopmental concerns (e.g., global developmental delay, ADHD, or learning disabilities). Out of the total cohort, 30 patients (7.3%) were identified as having potential genetic etiologies. Among them, most had unique variants, while two children shared a combined PICH-CDH3 mutation, two had confirmed SLC2A1 mutations, and two had SCN1A mutations. Additionally, Turner syndrome and Klinefelter syndrome were identified through karyotyping

Table 1 Sociodemographic characteristics of patients ($n=411$)

Sociodemographic characteristics	Frequency (N %)
Gender	
Male	276 (67.2%)
Female	135 (32.8%)
Current age of the patients	
Infant (up to 1 year)	5 (1.2%)
Toddler (1–3 years)	18 (4.4%)
Preschool (3–6 years)	60 (14.6%)
School-age (6–12 years)	144 (35.0%)
Adolescent (12–18 years)	156 (38.0%)
Age of onset of epilepsy	
Infant (up to 1 year)	79 (19.2%)
Toddler (1–3 years)	64 (15.6%)
Preschool (3–6 years)	85 (20.7%)
School-age (6–12 years)	158 (38.4%)
Adolescent (12–18 years)	25 (6.1%)
Residency	
Northern Region	294 (71.5%)
Central Region	115 (28.0%)
Southern Region	2 (0.5%)

Table 2 Etiology of seizures among patients ($n=411$)

Etiology	Frequency (N %)
Unknown	221 (53.8%)
Symptomatic	56 (13.6%)
Undetermined/cryptogenic	50 (12.2%)
Structural	38 (9.2%)
Genetic	30 (7.3%)
Metabolic	12 (2.9%)
Infectious	4 (1.0%)

in two patients. Other reported mutations included ADGRG1, ARFGEF1, CDKL5, CHD2, CLN6, CTNNA2, DCX + CAMSAP1, DEPDC5, among others. The types of testing utilized included karyotyping, targeted gene panels, and, in selected cases, whole-exome sequencing (WES).

In terms of the types of seizures identified among patients in our study, based on the ILAE 2017 classification of seizure types, focal onset seizures were the most common type, identified in 258 patients (62.8%), while 150 (36.5%) experienced generalized onset seizures, and 3 patients (0.7%) experienced unknown onset seizures.

Epilepsy syndromes

Regarding epilepsy syndrome, 88 patients (21.4%) had focal epilepsy syndromes, with Self-limited epilepsy with centrotemporal spikes (SeLECTs) (previously known as rolandic epilepsy) being the most prevalent (45 patients, 10.9%), followed by frontal lobe epilepsy (17 patients, 4.1%). In terms of specific epilepsy syndromes, 13 patients (3.2%) had West syndrome (infantile spasms), followed by 9 patients (2.2%) who had Developmental and epileptic encephalopathy (DEE). Table 3 provides additional information on epilepsy syndromes.

Table 3 Epilepsy syndromes among patients ($n=411$)

Epilepsy syndrome	Frequency (N %)
Focal epilepsies/syndromes	
Self-limited epilepsy with centrotemporal spikes (SeLECTs)	45 (10.9%)
Frontal epilepsy	17 (4.1%)
Occipital epilepsy	13 (3.2%)
Temporal epilepsy	12 (2.9%)
Parietal epilepsy	1 (0.2%)
Specific epilepsy syndrome	
West syndrome (infantile spasms)	13 (3.2%)
Developmental and epileptic encephalopathy (DEE)	9 (2.2%)
Juvenile myoclonic epilepsy	8 (1.9%)
Childhood absence epilepsy	3 (0.7%)
Juvenile absence epilepsy	2 (0.5%)
Benign myoclonic epilepsy in infancy	1 (0.2%)
Epilepsy with myoclonic-atonic seizures (Doose Syndrome)	1 (0.2%)
Severe myoclonic epilepsy in infancy (Dravet Syndrome)	4 (1.0%)
Acquired epileptic aphasia (Landau-Kleffner Syndrome)	2 (0.5%)
Developmental and/or epileptic encephalopathy with spike-wave activation in sleep (DEE/EE-SWAS)	1 (0.2%)

Table 4 Clinical and diagnostic characteristics of patients ($n=411$)

	Frequency (N %)
Family history	
No	365 (88.8%)
Yes	46 (11.2%)
Comorbidities	
None	212 (51.6%)
Developmental regression, plateauing	157 (38.2%)
Cognitive problems	112 (27.3%)
Behavioral problems	97 (23.6%)
Mood disorders	29 (7.1%)
Diagnostic tools	
EEG	405 (98.5%)
Neuroimaging (MRI, CT, HUS)	355 (86.4%)
Genetic testing	45 (10.9%)

Clinical and diagnostic characteristics

Table 4 shows a review of the clinical and diagnostic characteristics; only 46 (11.2%) patients had a family history of epilepsy; approximately half of the enrolled patients with epilepsy (51.6%) had no associated comorbidities; 157 (38.2%) had developmental abnormalities; and 112 (27.3%) had cognitive abnormalities.

In terms of epilepsy diagnostic tools, all patients received a thorough clinical evaluation by a pediatric neurologist; the vast majority of them underwent EEG testing (98.5%); brain imaging was completed in 86.4%;

however, genetic testing was performed infrequently, with only 10.9% of patients undergoing this test.

Management and ASMs

Medical records revealed that 148 (36%) of patients received treatment with only one ASM throughout their course of treatment, while 72 (17.5%) received two ASMs, 59 (14.4%) used three medications, and 62 (15.1%) received more than three ASMs. In 70 (17%) cases, no previous medication was used/identified i.e., the patient was medication naïve.

In terms of current medication use, 255 (62%) are on one ASM (monotherapy), 75 (18.2%) are on two ASMs, and 28 (6.8%) are taking three ASMs, the lowest percentage in this category. Notably, 53 (12.9%) of the patients are not on any active medication regimen.

As detailed in Table 5, Carbamazepine was the most commonly prescribed ASM, used by 211 patients (51.3%) of patients; sodium valproate by 184 patients (44.8%) came in second, followed by Lamotrigine which was used by 73 patients (17.8%). Levetiracetam was used by 57(13.9%) of cases, with Topiramate used in a smaller proportion 44 patient (10.7%). However, Ethosuximide, the first-line treatment for absence epilepsy, was used by only in 3 cases (0.7%). Based on the ILAE task force definition of DRE. Our study identified that 14 patients (3.4%) exhibit DRE.

Surgical procedures and ketogenic diet

Out of 411 patients, only four underwent surgical procedures: three had lesionectomy and one received VNS. The patients who underwent lesionectomy had focal structural lesions consistent with DRE focal epilepsy. Lesionectomy was effective in reducing seizure frequency in two patients and achieving complete seizure control in one. The patient who received VNS had generalized, DRE of unknown etiology; however, the intervention was ineffective in reducing seizure burden. None of the participants in our study were put on a keto diet. Although the Ketogenic Diet and new presurgical and surgical approaches have proven successful in many countries, their use in our country remains limited. Due to the retrospective nature of the study and the lack of consistent documentation, we were unable to determine how many patients were evaluated for or met the criteria for either surgical intervention or ketogenic dietary therapy.

Comorbidities according to the number of ASMs used

Table 6 shows a significant association ($p < 0.05$) between patients' comorbidities and the number of ASM they currently use. A total of 152 patients (71.6%) with no comorbidities are receiving monotherapy treatment.

Table 5 ASMs used by patients ($n = 411$)

Medications Used	Frequency (N %)
Carbamazepine	211 (51.3%)
Sodium valproate	184 (44.8%)
Lamotrigine	73 (17.8%)
Levetiracetam	57 (13.9%)
Clonazepam	46 (11.2%)
Topiramate	44 (10.7%)
Phenobarbitone	42 (10.2%)
Vigabatrin	29 (7.1%)
Primidone	19 (4.6%)
Clobazam	18 (4.4%)
Phenytoin	11 (2.7%)
Diazepam	5 (1.2%)
Lacosamide	4 (1.0%)
Ethosuximide	3 (0.7%)
Oxcarbazepine	2 (0.5%)
Perampanel	1 (0.2%)

Table 6 Association between the number of medications used and patient comorbidities

Number of drugs used currently	Comorbidities				
	Behavioral problems	Developmental regression	Cognitive problems	Mood disorders	None
None	9 (17%)	13 (24.5%)	8 (15.1%)	0	35
One	45 (17.6%)	83 (32.5%)	48 (18.8%)	12 (4.7%)	152
Two	29 (38.7%)	42 (56%)	37 (49.3%)	9 (12%)	20
Three	14 (50%)	19 (67.9%)	19 (67.9%)	8 (28.6%)	5
p-value*	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**

The values in bold are statistically significant

*Chi-square test

The relationship between seizure type and patient demographics, clinical features, and treatment-related variables

As shown in Table 7 [Additional file 4], titled "Statistical association between seizure type and demographic, clinical and treatment related variables", our study revealed a statistically significant association between the type of seizure and the age of onset of epilepsy in our patients (P value = 0.000). 47.4% of focal seizure patients are school-aged, while 26.7% of generalized seizure patients are preschool-aged. However, there was no significant association between seizure type and patient gender ($P = 0.052$). The findings also revealed a statistically significant relationship between the type of seizure and the etiology of epilepsy (P value = 0.001). Following cases with unknown etiology, focal seizures were the most frequent seizure type observed in patients with a structural cause, accounting for 12.4% of patients. In contrast, generalized seizures were most common in patients with symptomatic causes. This also applies to all comorbidities, except mood disorders, which had a P value of 0.364. Focal seizures were mostly associated with no comorbidities

(60%), whereas generalized seizures were mostly associated with developmental delay (51.3%). On the other hand, there was no significant association between seizure type and the number of ASMs used or DRE ($P = 0.104$ and 0.547, respectively). Only sodium valproate and clonazepam show a statistically significant relationship with seizure type ($P = 0.016$ and 0.048, respectively). However, carbamazepine was the most commonly used ASM for both focal and generalized seizures.

The relationship between DRE cases and clinical features, treatment-related variables

Our study found that 14 patients (3.4%) of children with epilepsy had DRE. There was a significant association between DRE and seizure onset age, with 6 of 14 (42.9%) DRE children being toddlers and 39.3% of responsive epilepsy children being school-aged ($p = 0.042$). DRE was associated with cognitive and developmental delays in 10 out of 14 children (71.4%) ($p < 0.05$). Genetic causes of seizures were linked to DRE, whereas symptomatic causes responded better to treatment than all other causes after the etiology of the seizure was unknown ($p = 0.02$). Table 8 titled "Statistical associations between DRE and clinical and treatment-related variables" indicates the statistical associations between the DRE cases and the age of onset of epilepsy, comorbidities, etiology Factors, and the currently used medications by the patients [Additional file 5].

Discussion

This study included pediatric patients who had a confirmed epilepsy diagnosis. Aiming to fill a critical knowledge gap in Palestine by studying age distribution, gender patterns, potential associations, and treatment to improve Palestinian physicians' knowledge and diagnostic and management methods for PE patients.

Our findings indicated that epilepsy was more common in males, making up 67% of cases. This is consistent with regional epidemiological studies conducted in Jordan (57% male prevalence), Saudi Arabia (81%), and India (69%) [11–13], further research is needed in our region to explore potential biological, social, or referral-related explanations for this observation.

Although it has been reported that family characteristics and genetic predisposition increase the risk of epilepsy in children [13]. 88.8% of children with epilepsy in our study did not have a positive family history of the condition. It may be associated with multiple reasons, including cultural issues, as patients and their families tend to hide medical conditions related to genetic causes. Moreover, they consider "family" to be first-degree members rather than extended relatives. Furthermore, people may consider only formally diagnosed epilepsy as relevant family history, ignoring isolated seizures or undiagnosed relatives. Therefore, it is essential for medical professionals to carefully elaborate on every detail and specifically inquire about cases of isolated seizures when compiling family medical histories, taking into account the social stigma that may influence families' willingness to disclose such information.

In concordance with the medical guidelines, EEG and brain images were done when indicated, but when it comes to genetic testing, only 10.9% of epilepsy patients underwent genetic testing. Currently, there are numerous genetic tests available for investigating the causes of epileptic diseases, including whole-genome sequencing (WGS), whole-exome sequencing (WES), different genetic epilepsy panels, karyotyping, and genomic microarrays. Genetic test results can have a positive impact on treatment plans, thereby improving patient care [14, 15]. According to a recent study, 49.8% of patients with epilepsy who received a genetic diagnosis had improvements in therapeutic outcome, and this shift often occurred within three months after the results (81.7%) [16], Despite their proven effectiveness in guiding diagnosis and targeted treatment, genetic tests remain significantly underutilized in our country. The primary barrier to wider use is their high cost, which places them out of reach for many families, particularly in the absence of insurance coverage. In addition to financial constraints, cultural concerns also play a role, especially in families where a genetic diagnosis may be perceived as stigmatizing or may raise concerns about future marriage prospects or family reputation. These factors contribute to limited acceptance and demand, even when testing is clinically indicated.

Looking at the treatment modalities, 62% of epilepsy patients are currently using a single ASM. NICE guidelines recommend that children should be treated with monotherapy whenever possible and that if initial treatment with a single ASM fails, the child should be treated with another single ASM [17]. Regardless of seizure type, Carbamazepine (211, 51.3%) was the most commonly used ASM, followed by Sodium valproate (184, 44.8%) and Lamotrigine (73, 17.8%). According to NICE guidelines, the first-line treatment for focal seizures is Lamotrigine or Levetiracetam, followed by Carbamazepine and Valproate for generalized seizures [17]. Although Ethosuximide is the first-line treatment for absence epilepsy, it was used by only 3 patients (0.7%).

This lack of use of recommended prescribed medications per international guidelines reflects the challenges our country faces. The decision to use ASMs is primarily complicated by drug availability challenges rather than misdiagnosis. For example, our center's EEG-confirmed absence epilepsy cases, but ethosuximide was frequently unavailable, neither by the national health insurance coverage nor routinely available for private purchase due to

supply chain limitations during the study period. This highlights the difficulty of adhering to standard treatment protocols due to our country's scarcity of essential medications, which frequently forces clinicians to prescribe medications that deviate from international treatment guidelines. This situation emphasizes the importance of increasing access to a wider range of ASMs in order to provide the best possible patient care.

In our study, the proportion of children identified with drug-resistant epilepsy (DRE) was 3.4%, which is substantially lower than the cumulative incidence reported in the literature. A recent systematic review and meta-analysis by Sultana et al. (2021) estimated the cumulative incidence of DRE in pediatric populations to be 25.0% [18]. Several methodological factors may explain this discrepancy. First, our study included only two outpatient clinics, which may have led to a selection bias by excluding patients referred to other institutions, particularly governmental hospitals or inpatient services, where more severe or treatment-resistant cases are typically managed due to the high cost of care. Second, incomplete documentation and missing follow-up data—often due to patients discontinuing care, relocating, or parents losing trust in the treatment process—likely contributed to underreporting. Cultural factors and socioeconomic challenges may also affect healthcare-seeking behaviors and long-term adherence to care, further limiting accurate case ascertainment. These methodological limitations emphasize the importance of comprehensive, multicenter data collection and long-term follow-up when estimating the true burden of DRE.

There are several surgical approaches to treating epilepsy, including lesionectomies, hemispherectmies, corpus callosotomy, neuromodulation with (VNS vagal nerve stimulator DBS deep brain stimulation, RNS) repetitive nerve stimulation, all with the goal of curing epilepsy, reducing seizure frequency or duration, preventing postoperative adverse reactions, and, to some extent, improving neurocognitive outcomes and quality of life [19, 20]. In our study, only 1% of patients received surgical treatment. We believe that these types of surgeries and techniques are still in an uncertain state for patients and families to approve of. Additionally, there is a significant shortage of trained professionals in epilepsy surgery, including neurosurgeons, neurophysiologists, neuroradiologists, and epilepsy specialists. The absence of specialized epilepsy centers, inadequate presurgical assessment, high cost, insufficient insurance or government funds, and a scarcity of physicians with experience in neurology, neurosurgery, neurophysiology, and neuroradiology all contribute to this issue. Meanwhile, our study found that 71.4% of children with DRE had cognitive and developmental impairment ($p < 0.05$). This highlights the importance of using alternative or advanced treatment methods, including newer ASMs and surgical interventions, to alleviate symptoms and improve quality of life.

The ketogenic diet (KD) is a low-carbohydrate, high-fat diet with either adequate or low protein, which causes the body to produce ketone bodies. According to clinical studies, this diet is indicated in cases of DRE where surgery is not indicated, or in specific neurological etiologies such as glucose transporter 1 deficiency syndrome caused by SLC2A1 mutation. Several KD types exist, including the low glycemic index treatment (LGIT), the modified Atkins diet (MAD), the medium-chain triglyceride (MCT) diet, and the classic ketogenic diet (CKD) [21]. The effectiveness of KD has been validated by meta-analysis studies, which also demonstrated that both classic KD and MAD had seizure frequency reductions (SFRs) of at least 50% [13]. KD has less disruptive effects on existing brain function than ASMs, and it is not only non-neurotoxic but also neuroprotective and disease-modifying. The effects of KDs could last much longer than medication therapy [22]. Despite the benefits of KD, it is still unavailable in our country.

Strengthens

This study has several key strengths, including being the first in Palestine to examine the clinical characteristics of epilepsy in children, thereby filling a critical gap in local research. It provides valuable insights into the clinical and therapeutic aspects of pediatric epilepsy (PE) in Palestine, offering a foundation for future healthcare planning and policy development. Additionally, by focusing on the pediatric population—an important yet often underrepresented segment of the community—our work addresses a high-priority area in public health. The findings serve as essential baseline data for future studies, enabling further research into epilepsy management, outcomes, and interventions in similar settings.

Limitations

This study has several limitations, including the collection of data from only two tertiary pediatric neurology clinics, which may introduce selection or referral bias, as patients in these settings likely present with more severe or complex conditions than the general population. The cross-sectional design makes it difficult to establish causality or assess long-term outcomes. Additionally, due to the retrospective nature of the study, we faced limitations in data availability, such as inconsistent records on anti-seizure medication doses, which hindered our ability to evaluate treatment adequacy and may have led to misclassifying some cases as drug-resistant when they could have been due to underdosing (i.e., pseudo-drug resistance). Moreover, our analysis was limited to descriptive and univariate methods due to the study's exploratory

nature. While this approach suited our objectives, multivariate analyses could provide a deeper understanding of independent associations in future studies.

Furthermore, as a study conducted in a low-resource country, many advanced investigations—particularly genetic testing and immunologic workups—were not routinely performed because these tests are typically paid for out-of-pocket by patients' families. This limitation likely led to incomplete etiologic classification and may have resulted in under-recognition of immune and genetic causes of epilepsy in our cohort.

Conclusion

Our study offers an assessment of PE in Palestine, filling critical knowledge gaps in the region. The results indicate that focal seizures are the most common type, with school-aged boys disproportionately affected. While older-generation anti-seizure medications (ASMs) are still commonly used, monotherapy was the most frequently adopted treatment approach, likely due to the predominance of focal seizures and limited availability of newer options. However, due to the lack of outcome metrics, the effectiveness of treatment cannot be definitively assessed. These findings underscore the challenges posed by limited access to newer treatments and advanced diagnostic methods, including genetic testing. Furthermore, the limited use of surgical and dietary interventions, such as the ketogenic diet, highlights the significant barriers to epilepsy management in the region.

Emerging insights into the associations between seizure type, comorbidities, etiologies, and age of onset suggest opportunities for more tailored clinical interventions. Overall, these results highlight the urgent need to improve access to diagnostic and therapeutic resources—particularly genetic testing and advanced treatment modalities—to better address the needs of pediatric patients with epilepsy.

Recommendations

We recommend further research to focus on and explore the prevalence of PE across diverse Palestinian regions, taking into consideration the economic and cultural factors that affect treatment access, studying the long-term side effects of ASMs, and raising awareness among families of epilepsy patients about the importance of advanced interventions such as the ketogenic diet and epilepsy surgery. Furthermore, we recommend conducting targeted research on the subgroup of patients who may benefit from genetic testing to better understand their clinical and genetic profiles and support more individualized treatment strategies. Additionally, future studies should investigate the use of traditional and non-medical treatments among families of children with epilepsy, especially given the limited access to healthcare resources, to better understand their influence on treatment decisions and outcomes.

Abbreviations

PE	Pediatric epilepsy
DRE	Drug-resistant epilepsy
EEG	Electroencephalography
ILAE	International league against epilepsy
ASM	Anti-seizure medication
MRI	Magnetic resonance imaging
CT	Computed tomography
HUS	Head ultrasound
SPSS	Statistical package for social sciences
VNS	Vagal nerve stimulation
WGS	Whole-genome sequencing
WES	Whole-exome sequencing
KGD	Ketogenic diet
LGIT	Low glycemic index treatment
MCT	Medium-chain triglyceride
CKD	Classic ketogenic diet
MAD	Modified Atkins diet
SFRs	Seizure frequency reductions

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12883-025-04447-3.

Additional file 1: Map of study centers and their coverage regions.

Additional file 2: Data Sheet: created to collect various study variables.

Additional file 3: Study variables: a detailed list of independent, dependent, and specific variables analyzed in our study.

Additional file 4: Table 7 "Statistical association between seizure type and demographic, clinical and treatment related variables": a table that provides information about the statistical associations between the seizure type and the gender, age of onset of epilepsy, comorbidities, etiology Factors, DRE, and the medications used by the patients.

Additional file 5: Table 8 "Statistical associations between DRE and clinical and treatment-related variables": a table that provides information about the statistical associations between the DRE and the age of onset of epilepsy, comorbidities, etiology Factors, and the medications used by the patients.

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Authors' contributions

AA played a significant role in providing references, contributing clinical data, and reviewing the literature. MA served as a primary source of clinical data through the review of patients' files. SN, KS, and OD were responsible for data collection, file reviewing, data analysis, and writing the results. RS and ZN provided overall supervision, with ZN offering specific guidance on data analysis. All authors read and approved the final manuscript.

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Data availability

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the IRB Committee at An-Najah National University (Ref: Med. April 2024/14), which granted permission to access and use participants' data before the start of the study. This retrospective study was based on previously recorded medical data, with no direct interaction with patients or their families. In accordance with the principles of the Declaration of Helsinki, the research respected participants' rights, dignity, and confidentiality. In accordance with the principles of the Declaration of Helsinki, the research respected participants' rights, dignity, and confidentiality. Per ethical guidelines, informed consent was not required, as the data were analyzed anonymously and all identifiable information was securely managed. Patient autonomy and privacy were safeguarded throughout the research process. All personal identifiers, including patient IDs, were anonymized to ensure strict confidentiality and compliance with data protection regulations. Additionally, approval to access and use patient files was obtained from the physicians responsible for the original documentation and the administrative authorities of the participating healthcare centers.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Medicine, Faculty of Medicine and Allied Medical Sciences, An-Najah National University, Nablus, Palestine
[2]Department of Pediatrics, Al-Quds University, Jerusalem, Palestine
[3]Department of Pediatrics, Child Neurologist and Epileptologist, Queens University, Kingston, ON, Canada

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