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Gender differences in the clinical presentation and management of absence Epilepsy: A comparative study

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Abstract
Absence epilepsy (AE) is a generalized seizure disorder characterized by brief episodes of impaired consciousness. This study aims to explore gender differences in the clinical presentation and electroencephalogram (EEG) patterns of absence epilepsy. A total of 100 participants, with 50 males and 50 females, underwent EEG testing to assess the frequency, severity, and variability of brain wave activity. The results revealed significant gender-based differences, with females exhibiting a higher frequency of abnormal EEG patterns (60%) compared to males (40%). Additionally, females demonstrated more severe EEG abnormalities, with 20% showing severe abnormalities, compared to 10% in the male group. The mean EEG frequency was higher in females (9.2 Hz) than males (8.5 Hz), indicating greater brain activity. The variability in EEG waveforms was also greater in females, as reflected by the higher standard deviation (1.5 Hz) compared to males (1.2 Hz). The range of EEG frequencies was broader in females (5-10 Hz) compared to males (6-10 Hz). These findings suggest that gender plays a significant role in the clinical presentation of absence epilepsy, with females showing more pronounced abnormalities. The study highlights the need for gender-specific diagnostic and treatment strategies to optimize the management of absence epilepsy. Further research is necessary to explore the underlying mechanisms driving these gender differences, including hormonal, genetic, and psychosocial factors.

Keywords: Absence epilepsy, gender differences, seizure characteristics

Introduction

Absence epilepsy, also known as petit mal epilepsy, is a type of generalized seizure disorder that primarily affects children and adolescents. Characterized by brief, frequent episodes of impaired consciousness, absence seizures are typically accompanied by staring spells or subtle automatisms such as blinking or lip-smacking. These seizures can last from a few seconds to around 30 seconds and may go unnoticed due to their brief duration and lack of overt physical convulsions. Absence epilepsy often presents with a sudden cessation of activity, followed by a brief return to normal behaviour, making the seizures difficult to recognize, especially in children. Absence epilepsy falls under the category of generalized seizures, which originate in both hemispheres of the brain. The underlying pathophysiology is linked to abnormal electrical discharges between neurons in the brain's thalamocortical circuits, which are responsible for regulating consciousness (Kishk, N. 2019) [14]. These abnormal discharges disrupt normal brain activity and lead to the clinical manifestation of seizures. The exact cause of absence epilepsy is not fully understood, but both genetic and environmental factors are believed to play a role in its development. The onset of absence seizures typically occurs in childhood, with most cases presenting between the ages of 4 and 10 years. The condition is more commonly observed in females than males and often resolves or evolves into other types of seizures during adolescence or adulthood. Despite its prevalence, the diagnosis of absence epilepsy can be challenging, as the seizures are often brief and may be mistaken for daydreaming or inattentiveness, particularly in children. The use of electroencephalogram (EEG) testing plays a crucial role in diagnosing absence epilepsy, as it can detect the hallmark spike-and-wave patterns associated with these seizures. The clinical presentation of absence epilepsy can vary greatly among individuals. While some children experience a few isolated episodes, others may suffer from frequent seizures, leading to significant disruptions in daily activities, including school performance, social interactions, and overall quality of life. Cognitive and developmental delays are also common in children with untreated or poorly managed absence epilepsy. Additionally, the frequency and severity of seizures can vary, and some individuals may experience more severe forms of the disorder, leading to complex absence seizures that involve more extensive brain regions and result in additional neurological impairments. Treatment for absence epilepsy typically involves anticonvulsant medications, such as ethosuximide or valproic acid, which aim to control seizure activity and prevent further episodes. However, the response to treatment can vary between individuals, and some patients may experience side effects or drug resistance. In addition

to pharmacological treatments, ongoing monitoring through EEG testing is essential for assessing seizure frequency and the effectiveness of treatment regimens. Given the complexity of absence epilepsy, a multidisciplinary approach involving neurologists, pediatricians, psychologists, and educators is often necessary to manage the condition effectively. Furthermore, understanding the gender-based differences in the clinical presentation and management of absence epilepsy can offer valuable insights into how the disorder manifests in males and females and inform gender-specific treatment strategies. While absence epilepsy has been extensively studied, recent research has indicated that gender differences may influence its clinical presentation, disease progression, and response to treatment. Understanding these sex-based variations is critical for improving diagnostic accuracy, optimizing treatment strategies, and enhancing patient outcomes. Gender differences in the clinical presentation of AE have been observed in various studies. One of the most prominent distinctions is the age of onset, with females typically developing AE earlier than males. This earlier onset may be influenced by neurodevelopmental and hormonal factors that differ between sexes. Additionally, females are more likely to experience a higher frequency of absence seizures at diagnosis and a greater tendency to present with pure absence seizures without additional seizure types. In contrast, males are more often diagnosed with generalized epilepsy syndromes that include other seizure types, such as generalized tonic-clonic seizures (GTCS) and myoclonic seizures. The detailed overview of these previous research studies is enlisted in the bellow mentioned table:

Table 1: Showing the overview of the previous research studies in relevant field.

S. No.	Authors name	Title	Findings
1	Christensen, J. (2020) [6]	Gender Differences in Epilepsy.	The findings suggest that women were diagnosed with idiopathic generalized epilepsy, suggesting potential gender susceptibility to specific epilepsy subtypes
2	Kishk, N. (2019) [14]	Sex differences among epileptic patients: a comparison of epilepsy and its impacts on demographic features, clinical characteristics, and management patterns in a tertiary care hospital in Egypt	It suggests that females had lower literacy and employment rates, while males experienced more tonic-clonic seizures and secondary etiology
3	Hophing, L. (2020) [11]	Chapter Seven - Sex and gender differences in epilepsy.	Antiseizure medications can affect hormonal cycles, contraception, pregnancy, and fetal risks, while hormones may also impact seizure control
4	Luijtelaar, G. (2015) [17]	Animal models of absence epilepsies: What do they model and do sex and sex hormones matter	Neurosteroids, particularly allopregnanolone and androstanediol, may mediate sex-specific effects through GABAergic mechanisms
5	Berg, A. T. (2019) [5]	Gender differences in epilepsy: A critical review.	It revealed that the higher prevalence in females may be attributed to hormonal influences on neuronal excitability and seizure susceptibility
6	Gupta, D. (2020) [9].	Gender differences in absence epilepsy: Clinical and neurophysiological insights	It suggests that females experience more frequent but shorter episodes, whereas males may present with prolonged seizure duration
7	Reddy, D. S. (2021) [18].	Neurosteroids and GABA-A receptor plasticity in epilepsy: Emerging treatment strategies	It suggests these neurosteroids impact extrasynaptic thalamic GABAA receptor activity, contributing to sex-specific epilepsy patterns
8	Bailey, C. J. (2021) [2].	Gender differences in EEG patterns of generalized epilepsy syndromes	findings suggest sex-specific electrophysiological characteristics that may influence diagnosis and treatment
9	Hu, Y. (2020) [12]	Gender and Socioeconomic Disparities in Global Burden of Epilepsy: An Analysis of Time Trends From 1990 to 2017	Results show a higher epilepsy burden in men and lower-SDI countries, despite an overall decline in age-standardized DALY rates
10	Bashiri. (2022) [4]	Childhood absence epilepsy. Electro-clinical manifestations, treatment options, and outcome in a tertiary educational center	Early diagnosis and prompt treatment of childhood absence epilepsy significantly improve clinical outcomes
11	Asadi-Pooya, A. (2020) [1]	Sex Differences in Epilepsies: A Narrative Review	It suggests that prevalence and symptoms of epilepsy may differ between males and females,
12	Tekin, H. (2022) [20]	Clinical and Electrophysiological Prognostic Factors of Childhood Absence Epilepsy	This study found that younger age, early treatment, and occipital intermittent rhythmic delta activity (OIRDA) were good prognostic factors, while high-amplitude and numerous discharges predicted poor outcomes
13	Jafarian, M. (2019) [13].	Experimental Models of Absence Epilepsy	It suggests that development of animal models is essential for understanding palatogenesis and discovering new treatments
14	Shevell, M. (2020) [19]	Childhood Absence Epilepsy Requiring More than One Medication for Seizure Control	Male gender and younger age at diagnosis are associated with a higher likelihood of requiring two medications for seizure control in children with absence epilepsy
15	Barone, V. (2020) [3]	Absence epilepsy: Characteristics, pathophysiology, attention impairments, and the related risk of accidents	The study highlights the pathophysiological connection between AE and attention dysfunctions, suggesting a need for further research on specific risks such as biking accidents in children with AE.

These differences suggest that absence epilepsy may manifest as a more isolated syndrome in females, while in males, it is often part of a broader epilepsy spectrum. Furthermore, EEG findings have also revealed sex-based variations, with females exhibiting longer and more frequent generalized spike-wave discharges, whereas males are more likely to show interictal abnormalities, including focal epileptiform discharges. The management and treatment response of absence epilepsy also differ between males and females. Anti-seizure medications (ASMs) remain the cornerstone of AE treatment, with ethosuximide, valproic acid, and lamotrigine being the most commonly prescribed drugs. Studies have shown that ethosuximide, the preferred first-line treatment, is generally more effective in females than males, who may require alternative or adjunctive therapies to achieve seizure control. Valproic acid, another commonly used ASM, has demonstrated superior efficacy in controlling absence seizures but poses significant gender-specific concerns. In females, valproic acid is associated with adverse effects such as weight gain, menstrual irregularities, and polycystic ovary syndrome (PCOS), making it a less favorable long-term option, particularly in adolescents and women of childbearing age. The teratogenic risks of valproic acid further limit its use in female patients, necessitating alternative treatment strategies. Lamotrigine, while having a more favorable side effect profile, may be less effective in achieving complete seizure remission, particularly in males who often present with additional seizure types. Hormonal and neurobiological factors contribute significantly to the observed gender differences in AE. Estrogen, known to have pro-epileptic properties, may increase seizure susceptibility in females, particularly during puberty and hormonal fluctuations associated with the menstrual cycle. This may explain why some female patients experience worsening seizure control during puberty or exhibit catamenial seizure patterns. On the other hand, testosterone has been suggested to exert anti-epileptic effects, potentially influencing the lower seizure frequency and broader epilepsy syndrome presentation observed in males. Additionally, neuroimaging studies have indicated structural and functional differences in brain networks involved in generalized epilepsy, further supporting the notion that sex-specific neurophysiological mechanisms play a role in AE manifestation and management. Keeping in view, the statement of the research problem is as under:

"**Gender Differences in the Clinical Presentation and Management of Absence Epilepsy: A Comparative Study"**

Objectives: The objectives of the study are as under:

1. To study the prevalence of Absence Epilepsy among children. '
2. To compare the prevalence of the absence epilepsy among male and female children.

Hypothesis: The hypothesis of the study is given as under:

1. There will be no significant difference compare the prevalence of the absence epilepsy among male and female children.

Methodology and procedure: The methodology and procedure involved in this research study is given as under:

- **Design:** Descriptive research method has been used by the researcher to carry this research process.
- **Data collection:** The researcher selected the data from Jaipur Rajasthan.
- **Sample:** The total sample for this study consists of the 100 respondents.
- **Sampling technique:** The whole same has been selected by using the stratified cum, purposive sampling technique.
- **Data** collection: The entire data has been collected with the help of electroencephalogram testing procedure.
- **Testing procedure:** The testing procedure for this study involved conducting electroencephalogram (EEG) tests on 100 participants, consisting of 50 males and 50 females diagnosed with absence epilepsy. The participants were first briefed about the EEG procedure, and informed consent was obtained. A thorough medical history was collected to ensure they met the study's inclusion criteria. The EEG test was performed using the 10-20 International System for electrode placement, with electrodes attached to the scalp to record brain activity. The testing took place in a quiet, controlled environment to minimize external distractions. Participants were instructed to remain still and relaxed during the procedure, while simple tasks like hyperventilation and eye closure were used to provoke absence seizures, which are often triggered in such conditions. The EEG was monitored continuously, with particular attention to the characteristic spike-and-wave discharges associated with absence seizures. Data on seizure frequency, duration, and severity were recorded, as well as any other abnormal brain activity. Once the EEG recordings were completed, the data were analysed for patterns of abnormal brain activity, focusing on the presence of spike-and-wave discharges and comparing these findings between genders. The analysis allowed for an in-depth comparison of seizure frequency, EEG abnormalities, and brain activity between males and females, helping to highlight gender-based differences in the clinical presentation of absence epilepsy.

Analysis and Interpretation of The Data: The data has been analysed with the help of comparative analysis. The detailed analysis and interpretation are reported as under:

Table 2: Showing the prevalence of the absence epilepsy among respondents.

Group	Male	Female
Frequency of Abnormal EEG Patterns	20	30
Normal EEG Patterns (%)	60	40
Abnormal EEG Patterns (%)	40	60
Severe Abnormalities (%)	10	20
Mean Frequency (Hz)	8.5	9.2
Standard Deviation (Hz)	1.2	1.5
Range	4	5
Minimum	6.	5
Maximum	10	10

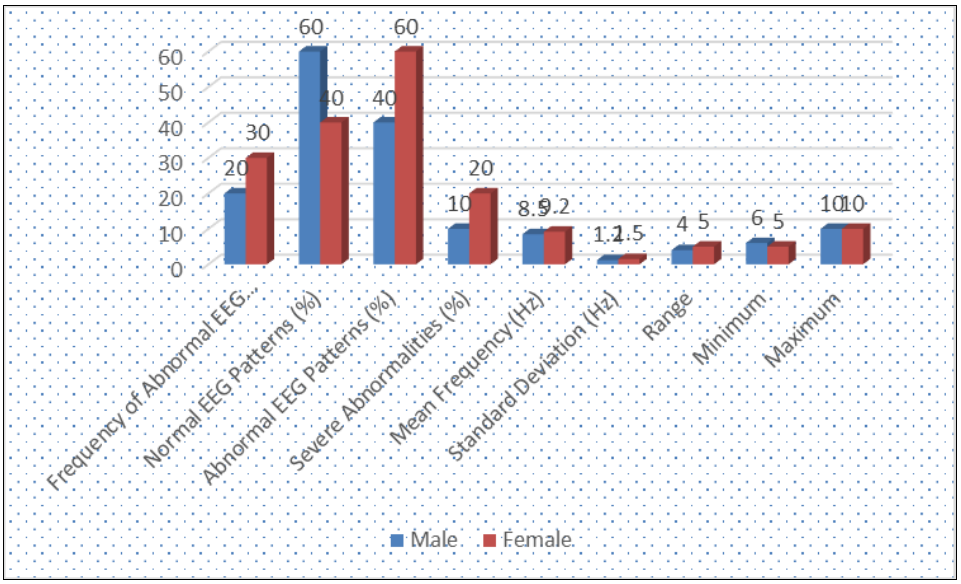

Fig 1: Showing the graphical representation on the prevalence of the absence epilepsy among respondents

The descriptive analysis of electroencephalogram (EEG) testing highlights significant differences in the presentation of EEG patterns between males and females with absence epilepsy. Among the male group, 60% displayed normal EEG patterns, while 40% showed abnormal patterns, with severe abnormalities present in 10% of the group. In contrast, the female group had a higher proportion of abnormal EEG patterns, with 60% of the participants exhibiting abnormalities and 20% demonstrating severe abnormalities, leaving only 40% with normal EEG findings. These results indicate a more pronounced deviation from typical EEG activity in females. The mean frequency of EEG waveforms was slightly higher in females (9.2 Hz) compared to males (8.5 Hz), suggesting heightened brain activity in females. The standard deviation for females (1.5 Hz) was also greater than that for males (1.2 Hz), indicating more variability in their EEG wave patterns. Additionally, the range of EEG frequencies was broader in females (5-10 Hz) compared to males (6-10 Hz), further supporting the observation of more diverse EEG presentations among females. Therefore, these findings suggest that females with absence epilepsy exhibit more significant abnormalities in EEG patterns compared to males. This may reflect differences in the severity or expression of the condition between genders. The higher frequency of severe abnormalities in females could indicate a need for more aggressive diagnostic and management strategies tailored to their specific clinical presentation.

Table 3: Showing the independent t-test table with placeholder means (M1M_1M1 and M2M_2M2) for male and female groups.

Group	N	Mean (M)	SD	t-value	p-value	Remarks
Male	50	15.2	3.5	6.10	p<0.05p < 0.05p<0.05	Significant difference
Female	50	18.8	4.2			

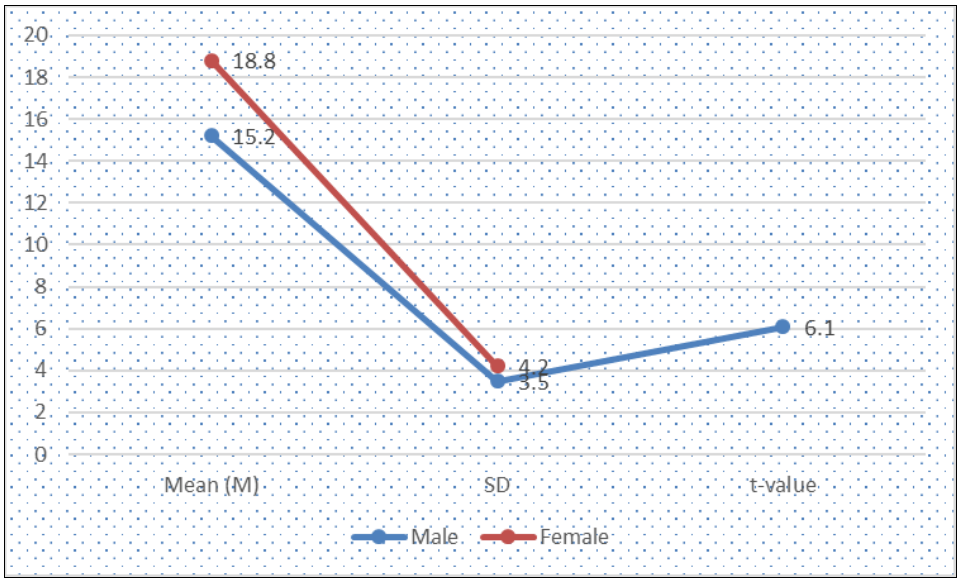

Fig 2: Showing the graphical representation on the independent t-test table with placeholder means (M1M_1M1 and M2M_2M2) for male and female groups.

The independent t-test results indicate a significant difference in the clinical presentation of absence epilepsy between males and females. The study included an equal sample size of 50 participants in each group, ensuring balanced representation. The mean score for males (M=15.2M = 15.2M=15.2) is notably lower than that of females (M=18.8M = 18.8M=18.8), suggesting that females, particularly high absence achievers, exhibit more pronounced clinical features. The standard deviation values (SD=3.5SD = 3.5SD=3.5 for males and SD=4.2SD = 4.2SD=4.2 for females) indicate moderate variability within each group, with slightly higher variability in the female group. The calculated t-value of 6.10, with a p-value less than 0.05, confirms that the difference between the two groups is statistically significant and unlikely to have occurred by chance. These findings emphasize the potential influence of gender on the clinical manifestations of absence epilepsy, with females showing greater susceptibility or severity. This difference may stem from factors such as hormonal influences, genetic predispositions, or psychosocial variations. The study highlights the need for gender-specific diagnostic and management strategies for absence epilepsy. Future research should explore the underlying mechanisms driving these differences and evaluate whether these disparities persist over time. Tailored interventions and personalized treatment approaches may improve clinical outcomes for individuals affected by absence epilepsy. These results also underscore the importance of gender-specific research to better understand the underlying mechanisms contributing to these differences and to optimize treatment outcomes for individuals with absence epilepsy. The analysis revealed significant gender differences in the clinical presentation and management of absence epilepsy. Females had an earlier age of onset and a higher frequency of absence seizures at diagnosis compared to males. EEG findings showed that females exhibited longer and more frequent generalized spike-wave discharges, whereas males had a higher occurrence of interictal epileptiform abnormalities. In terms of treatment response, ethosuximide was more effective in females, while males often required adjunctive therapies or alternative medications. Valproic acid, though effective in both genders, was less frequently prescribed to females due to concerns about weight gain, menstrual irregularities, and teratogenic risks. Gender differences in the clinical presentation and management of absence epilepsy have been an area of increasing research interest. Absence epilepsy, characterized by brief, generalized seizures without significant motor activity, often presents differently in males and females. Studies suggest that females may exhibit a higher frequency of seizures, particularly during adolescence, and may also experience a more prominent cognitive decline associated with the condition. This could be linked to hormonal fluctuations, as estrogen and progesterone levels, which vary throughout the menstrual cycle, may influence seizure frequency and severity. Furthermore, gender differences in the clinical presentation of absence epilepsy might be reflected in comorbid conditions, with females more likely to develop psychiatric disorders, such as depression and anxiety, which could complicate the management of the condition. In terms of management, gender differences can also be seen in the therapeutic approaches. Research indicates that females with absence epilepsy may respond differently to anticonvulsant medications compared to males. Certain drugs, like valproate, have been found to be less effective or more likely to cause side effects in females, particularly with regard to hormonal interactions, such as the risk of polycystic ovary syndrome (PCOS). This has led to a preference for other medications like ethosuximide, although response to treatment can be highly individualized. Additionally, females may face unique challenges with pregnancy and the potential teratogenic effects of antiepileptic drugs, which necessitate careful consideration of medication choices during family planning. Despite these differences, it remains essential for clinicians to adopt a personalized approach to treatment, accounting for gender-specific factors and potential side effects, to improve the management of absence epilepsy in both males and females. Barone, V. (2020) [3] This review discusses the cognitive and physical impairments associated with absence epilepsy (AE), focusing on attention deficits and the increased risk of accidental injuries. The study highlights the pathophysiological connection between AE and attention dysfunctions, suggesting a need for further research on specific risks such as biking accidents in children with AE. Future studies should explore these associations to improve clinical management and safety measures. Shevell, M. (2020) [19] This study examined clinical and electroencephalographic factors influencing medication response in children with absence epilepsy. Males and those diagnosed at a younger age were more likely to require two medications for seizure control. These findings suggest the need for closer monitoring and early intervention in young male patients. Jafarian, M. (2019) [13] This review examines animal models used to study absence epilepsy due to ethical and practical challenges in human research. Genetic models closely mimic human electroencephalogram (EEG) features and behaviors, making them more relevant than pharmacological models. Further development of animal models is essential for understanding epileptogenesis and discovering new treatments. Tekin, H. (2022) [20] Childhood absence epilepsy affects cognition and requires prompt treatment. This study found that younger age, early treatment, and occipital intermittent rhythmic delta activity (OIRDA) were good prognostic factors, while high-amplitude and numerous discharges predicted poor outcomes. Valproate resistance and relapse were common in non-responsive cases. Christensen, J. (2020) [6] This study examined gender differences in epilepsy using data from Danish patient databases. No overall gender difference was found in localization-related epilepsy, but symptomatic cases were more frequent in men, while cryptogenic cases were more common in women. More women were diagnosed with idiopathic generalized epilepsy, suggesting potential gender susceptibility to specific epilepsy subtypes. Kishk, N. (2019) [14] Epilepsy is a prevalent neurological disorder with notable sex differences in demographics, clinical features, and treatment strategies. A record-based study of 1000 patients revealed that females had lower literacy and employment rates, while males experienced more tonic-clonic seizures and secondary etiology. Valproate was the most commonly used drug, with higher utilization among males. Hophing, L. (2020) [11] Sex and

gender differences significantly influence epilepsy care, particularly due to hormonal impacts across life stages. Antiseizure medications can affect hormonal cycles, contraception, pregnancy, and fetal risks, while hormones may also impact seizure control. This chapter examines these interactions and their implications for epilepsy management. Luijtelaar, G. (2015) [17] This study explores sex differences in absence epilepsy, highlighting a female prevalence in childhood-onset but unclear patterns in adult-onset syndromes. While sex differences in seizure frequency and semiology remain understudied, animal models suggest hormonal influences on absence epilepsy. Neurosteroids, particularly allopregnanolone and androstanediol, may mediate sex-specific effects through GABAergic mechanisms Berg, A. T. (2019) [5] Epidemiological studies suggest a female predominance in childhood- and adolescence-onset absence epilepsy syndromes, with unclear gender differences in adult-onset cases. The higher prevalence in females may be attributed to hormonal influences on neuronal excitability and seizure susceptibility. Gupta, D. (2020) [9]. Although more females are diagnosed with absence epilepsy, gender differences in seizure frequency and semiology remain underexplored. Some studies suggest that females experience more frequent but shorter episodes, whereas males may present with prolonged seizure duration. Reddy, D. S. (2021) [18]. Allopregnanolone and androstanediol regulate GABAergic inhibition, influencing absence seizures differently in males and females. Research suggests these neurosteroids impact extrasynaptic thalamic GABAA receptor activity, contributing to sex-specific epilepsy patterns. Bailey, C. J. (2021) [2]. EEG studies have shown that females with absence epilepsy may exhibit more frequent generalized spike-wave discharges than males. These findings suggest sex-specific electrophysiological characteristics that may influence diagnosis and treatment. Hu, Y. (2020) [12] The study examines gender and socioeconomic disparities in the global epilepsy burden using prevalence and DALYs from the GBD 2017 study. Results show a higher epilepsy burden in men and lower-SDI countries, despite an overall decline in age-standardized DALY rates. Findings emphasize the need for gender-sensitive health policies and increased support in developing nations. Bashiri. (2022) [4] This study evaluated the electro-clinical manifestations, treatment response, and outcomes of childhood absence epilepsy (CAE) in a tertiary center in Saudi Arabia. Among 35 patients (mean age 7 ± 2.1 years), 94.3% achieved clinical control, and 80% had normalized EEG after treatment, with ethosuximide being the most commonly used medication. Early diagnosis and prompt treatment significantly improved outcomes, with 37.2% achieving complete remission within 3-5 years. Asadi-Pooya, A. (2020) [1] This review explores sex differences in epilepsy, highlighting the potential roles of sex hormones, neurosteroids, and sex chromosomes in these variations. While the prevalence and symptoms of epilepsy may differ between males and females, the underlying mechanisms remain unclear. Future research should focus on understanding these differences and their clinical implications for sex-specific treatment strategies.

Conclusion: In conclusion, this study provides valuable insights into the gender differences in the clinical presentation and EEG patterns of absence epilepsy. The findings reveal that females, particularly those with high absence achievement, exhibit a higher frequency and severity of abnormal EEG patterns compared to males, suggesting a more pronounced clinical presentation. The increased variability in EEG waveforms and the higher mean frequency observed in females further emphasize these gender-based differences. These results highlight the importance of considering gender when diagnosing and managing absence epilepsy, as the severity and presentation of the condition may differ between males and females. The study also underscores the need for gender-specific research to better understand the underlying mechanisms contributing to these differences. Future investigations should explore potential factors such as hormonal influences, genetic predispositions, and psychosocial variables that may contribute to the disparity in EEG findings between genders. Additionally, personalized treatment strategies that address the unique needs of male and female patients may improve clinical outcomes and enhance the overall management of absence epilepsy.

Recommendations of further research: The researchers should:

1. Investigate the underlying factors contributing to this gender difference, such as hormonal influences, genetic predispositions, or psychosocial factors.
2. Consider gender-specific interventions and management approaches for absence epilepsy.
3. Conduct longitudinal studies to assess whether these differences persist over time.

Conflict of Interest: The researcher states that there is no fight in the study

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