



RESEARCH ARTICLE

Clinical Profile and Treatment Outcome of Infantile Spasms Of varied etiology: A Hospital-Based Observational Study

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ABSTRACT

Objective: To evaluate the clinical profile, neuroimaging and electroencephalographic findings, and outcomes among children diagnosed with infantile spasms.

Methods: This prospective observational hospital-based study was conducted in the Department of Pediatrics, S.C.B. Medical College and Hospital and SVPPGIP, Cuttack, Odisha, from August 2023 to July 2025. Fifty children clinically diagnosed with infantile spasms and/or confirmed with electroencephalography (EEG) findings were included. Demographic details, perinatal history, developmental status, EEG and magnetic resonance imaging (MRI) findings, type of spasms, and treatment response to adrenocorticotrophic hormone (ACTH) were analyzed.

Results: Among the 50 children enrolled, 26 (52%) were females and 24 (48%) were males. Majority of children (94%) belonged to the age group of 6 months to 2 years. History suggestive of birth asphyxia was present in 80% of cases. Developmental delay was observed in 76% of children. Flexor spasms were the most common type (62%), followed by mixed spasms (22%) and extensor spasms (16%). EEG abnormalities were noted in 48% and MRI abnormalities in 42% of children. Complete seizure control with ACTH therapy was achieved in all children with extensor spasms, 74.2% of children with flexor spasms, and 54.5% of children with mixed spasms. A statistically significant association was observed between developmental outcome after follow-up and type of spasm ($p=0.043$).

Conclusion: Infantile spasms commonly present between 6 months and 2 years of age and are frequently associated with birth asphyxia and developmental delay. Flexor spasms were the predominant presentation. ACTH therapy achieved favorable seizure control, particularly in children with extensor and flexor spasms. Early recognition and prompt treatment may improve both seizure and developmental outcomes.

Keywords: Infantile spasms; West syndrome; ACTH; Developmental delay; EEG; MRI

Indian J. Pharm. Biol. Res. (2026); <https://doi.org/10.30750/ijpbr.14.4.33>

INTRODUCTION

Infantile Epileptic Spasms Syndrome (IESS), previously known as West syndrome, is a severe developmental and epileptic encephalopathy characterized by epileptic spasms, a characteristic electroencephalographic (EEG) pattern known as hypsarrhythmia, and developmental delay or regression (1-3). Originally described by William James West in 1841, the disorder predominantly affects infants during the first year of life, with peak onset between 3 and 7 months of age^(2,4). The term IESS has recently been adopted by the International League Against Epilepsy (ILAE) to encompass children with epileptic spasms who do not fulfill all classical criteria of West syndrome (1).

IESS is broadly classified into symptomatic, cryptogenic, and idiopathic forms⁽³⁾. Symptomatic cases account for the majority and have an identifiable underlying cause.^(3,5) Prenatal causes include structural brain malformations such as cortical dysplasia, lissencephaly, and hemimegalencephaly; neurocutaneous disorders,

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How to cite this article: Jalan A, Agarwalla SK, Kishan S. Clinical Profile and Treatment Outcome of Infantile Spasms Of varied etiology: A Hospital-Based Observational Study. Indian J. Pharm. Biol. Res. 2026;14(4):236-241.

Source of support: Nil

Conflict of interest: None.

Received: 22/08/2026 **Revised:** 03/09/2026 **Accepted:** 20/09/2026

particularly tuberous sclerosis complex; chromosomal abnormalities such as Down syndrome; genetic mutations; and inborn errors of metabolism.^(3,5,6) Perinatal causes include hypoxic-ischemic encephalopathy, neonatal hypoglycemia,

prematurity, and low birth weight^(3,5). Postnatal etiologies include central nervous system infections, traumatic brain injury, tumors, and other acquired brain insults^(3,5).

Cryptogenic IESS refers to cases without an identifiable etiology despite extensive evaluation, while idiopathic IESS is characterized by normal development before onset, normal neurological examination, normal neuroimaging, and absence of an identifiable cause⁽³⁾. Children with cryptogenic or idiopathic IESS generally have a better prognosis than those with symptomatic disease^(3,7). Current evidence suggests that epileptic spasms may result from a nonspecific insult occurring during a critical period of brain development^(4,8). Dysregulation of the hypothalamic-pituitary-adrenal axis and abnormalities in cortical and brainstem networks have also been implicated^(4,8). The therapeutic response to adrenocorticotrophic hormone (ACTH) supports the role of neuroendocrine mechanisms in disease pathogenesis^(4,8).

The hallmark feature of IESS is the occurrence of epileptic spasms involving the neck, trunk, and limbs^(3,4). Spasms may be flexor, extensor, or mixed and typically occur in clusters, especially upon awakening⁽³⁾. Each spasm consists of a brief contraction lasting less than two seconds followed by a tonic phase lasting several seconds⁽³⁾. Associated manifestations include motor arrest, abnormal eye movements, autonomic changes, and developmental regression^(3,4). Loss of previously acquired milestones such as sitting, crawling, babbling, and social interaction is common^(3,7).

Diagnosis relies primarily on EEG, which characteristically demonstrates hypsarrhythmia, a chaotic high-voltage pattern of multifocal spikes and slow waves^(1,3). Brain MRI is essential for identifying structural causes and can establish the etiology in a significant proportion of patients^(5,6). When routine evaluation is inconclusive, metabolic investigations and genetic testing, including epilepsy gene panels and whole-exome sequencing, may help identify the underlying cause^(5,6,9).

Treatment should be initiated promptly after diagnosis^(7,10). First-line therapies include hormonal treatment with ACTH or corticosteroids and the antiseizure medication vigabatrin^(7,10). ACTH remains one of the most effective treatments, while vigabatrin is particularly beneficial in children with tuberous sclerosis complex^(7,10). Combination therapy may improve treatment outcomes.¹⁰ Alternative therapies for refractory cases include the ketogenic diet and epilepsy surgery in selected patients with focal structural lesions^(7,10).

Outcome depends largely on etiology, age at treatment

initiation, and response to therapy.^{3,7} Early recognition and rapid initiation of effective treatment are critical for improving neurodevelopmental outcomes and reducing long-term epilepsy-related morbidity.^(7,10)

MATERIALS AND METHODS

This prospective observational hospital-based study was conducted in the Department of Pediatrics, S.C.B. Medical College and Hospital and SVPPGIP, Cuttack, Odisha, from August 2023 to July 2025.

Children diagnosed clinically with infantile spasms and with or without EEG findings were included in the study. Children whose parents did not provide consent and those who failed to complete at least 6 months of follow-up were excluded.

A total of 50 children were enrolled using convenience sampling. Detailed demographic data, perinatal history, developmental history, clinical characteristics of spasms, EEG findings, MRI brain findings, and response to treatment were recorded using a structured case record form.

All children underwent EEG and MRI brain evaluation. Developmental status was assessed clinically during follow-up visits. ACTH was administered to all patients, and treatment response was categorized as controlled, partially controlled, or not controlled.

Data were analyzed using SPSS version 21. Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as frequency and percentage. Chi-square test was used for comparison of categorical variables. A *p* value <0.05 was considered statistically significant.

The study was approved by the Institutional Ethics Committee of S.C.B. Medical College and Hospital, Cuttack. Written informed consent was obtained from parents or guardians prior to enrollment.

OBSERVATION & RESULTS

A total of 50 children diagnosed with Infantile Epileptic Spasms Syndrome (IESS) were included in the study. Their demographic characteristics, clinical profile, neuroimaging findings, electroencephalographic features, treatment response, and developmental outcomes were analyzed.

Among the 50 enrolled children, 48 (96%) were younger than 2 years, with the majority (94%) belonging to the 6 months–2 years' age group. Females slightly outnumbered males (52% vs. 48%). Normal vaginal delivery was reported in 52% of cases, while 48% were delivered by lower segment cesarean section. A history of birth asphyxia was present in 80% of children, and developmental delay was observed in 76%, indicating that

perinatal insult and neurodevelopmental impairment were common among children with infantile spasms.

Flexor spasms were the predominant seizure type, occurring in 31 (62%) children, followed by mixed spasms in 11 (22%) and extensor spasms in 8 (16%). EEG abnormalities were detected in 24 (48%) patients, whereas MRI abnormalities were observed in 21 (42%). These findings suggest that although nearly half of the patients demonstrated abnormal neurophysiological and neuroimaging findings, a substantial proportion had normal investigations despite clinical infantile spasms.

Most children with all three spasm types were between 6 months and 2 years of age. Birth asphyxia was more frequent among children with mixed (100%) and extensor (87.5%) spasms than among those with flexor spasms (71%). MRI abnormalities were relatively more common in mixed spasms (63.6%) than in flexor spasms

(32.3%). However, none of the demographic or clinical variables showed a statistically significant association with spasm type (all $p > 0.05$).

Statistical analysis demonstrated no significant association between the type of spasm and age group ($p = 0.380$), sex ($p = 0.465$), mode of delivery ($p = 0.225$), birth asphyxia ($p = 0.100$), EEG findings ($p = 0.461$), or MRI abnormalities ($p = 0.171$). These observations indicate that the clinical subtype of infantile spasms was independent of these baseline demographic and radiological characteristics.

Complete seizure control following ACTH therapy was achieved in 100% of children with extensor spasms, compared with 74.2% of children with flexor spasms and 54.5% of those with mixed spasms. Although extensor spasms showed the highest treatment response, the association between seizure control and spasm type did not reach statistical significance ($p = 0.083$).

Developmental delay persisted in the majority of children after follow-up. All children with mixed spasms (100%) continued to demonstrate developmental delay, compared with 87.5% of children with extensor spasms and 64.5% of those with flexor spasms. A statistically significant association was observed between spasm type and developmental outcome ($p = 0.043$), indicating that children with mixed spasms had comparatively poorer developmental outcomes.

DISCUSSION

In the present study, the majority of children (94%) were between 6 months and 2 years of age at presentation, which is consistent with the recognized age of onset of Infantile Epileptic Spasms Syndrome (IESS). Previous studies have similarly demonstrated that infantile spasms predominantly occur during infancy, with peak onset within the first two years of life. (1,3,4)

Females constituted 52% of the study population and males 48%, indicating no significant sex predilection. Although some studies have reported a slight male predominance, the overall evidence suggests that IESS affects both sexes relatively equally. (1,3)

Birth asphyxia was identified in 80% of patients, highlighting the significant contribution of perinatal hypoxic-ischemic injury to the development of infantile spasms. Perinatal brain injury is a well-recognized cause of symptomatic IESS and remains an important etiological factor, particularly in low- and middle-income countries where perinatal complications continue to contribute substantially to childhood neurological morbidity. (3-5) Flexor spasms were the most common seizure semiology,

Table 1: Demographic and Clinical Characteristics of Study Participants (n=50)

Variable	Frequency	Percentage
Age 0-6 months	0	0
Age 6 months–2 years	48	94
Age >2 years	2	6
Male	24	48
Female	26	52
Normal vaginal delivery	26	52
LSCS	24	48
Birth asphyxia present	40	80
Birth asphyxia absent	10	20
Developmental delay present	38	76
Developmental delay absent	12	24

Table 2: Clinical and Radiological Profile of Infantile Spasms (N=50)

Parameter	Frequency (n)	Percentage (%)
Flexor spasms	31	62
Extensor spasms	8	16
Mixed spasms	11	22
EEG abnormal	24	48
EEG normal	26	52
MRI abnormal	21	42
MRI normal	29	58

Table 3: Distribution of subjects according to clinical profile, EEG , MRI and type of spasm

Variable	Category	Extensor n (%)	Flexor n (%)	Mixed n (%)	p value
Age group	6 months–2 years	7 (87.5)	30 (96.8)	11 (100)	0.380
	>2 years	1 (12.5)	1 (3.2)	0	
Sex	Female	5 (62.5)	17 (54.8)	4 (36.4)	0.465
	Male	3 (37.5)	14 (45.2)	7 (63.6)	
Mode of delivery	LSCS	5 (62.5)	16 (51.6)	3 (27.3)	0.225
	NVD	3 (37.5)	15 (48.4)	8 (72.7)	
Birth asphyxia	Present	7 (87.5)	22 (71.0)	11 (100)	0.100
	Absent	1 (12.5)	9 (29.0)	0	
EEG findings	Abnormal	4 (50.0)	13 (41.9)	7 (63.6)	0.461
	Normal	4 (50.0)	18 (58.1)	4 (36.4)	
MRI findings	Abnormal	4 (50.0)	10 (32.3)	7 (63.6)	0.171
	Normal	4 (50.0)	21 (67.7)	4 (36.4)	

accounting for 62% of cases, followed by mixed spasms (22%) and extensor spasms (16%). This pattern is consistent with the classical description of infantile spasms, in which flexor spasms represent the most frequently encountered clinical presentation. (3,4)

Electroencephalographic abnormalities were observed in 48% of children at the time of evaluation. Variability in EEG findings may be related to timing of EEG acquisition, prior treatment exposure, and evolution of electroclinical patterns. EEG remains the cornerstone of diagnosis in IESS and is essential for identifying characteristic abnormalities such as hypsarrhythmia and its variants. (1,3) No significant association was found between EEG abnormalities and seizure semiology in the present study, suggesting that EEG findings may reflect underlying cerebral dysfunction rather than the specific clinical type of spasm.

Magnetic resonance imaging abnormalities were observed in 42% of patients, highlighting the importance of neuroimaging in identifying underlying structural etiologies. Previous studies have demonstrated that structural brain abnormalities are among the most common causes of infantile spasms and may influence both seizure control and long-term developmental outcome. (5,6,9) However, similar to our findings, no significant relationship was observed between MRI abnormalities and the type of spasm.

Developmental delay was present in 76% of children, emphasizing the profound neurodevelopmental impact of IESS. Developmental impairment is a well-recognized feature of the disorder and contributes substantially to long-

Table 4: Association Between Clinical Variables and Type of Spasm

Variable	p-value	Statistical significance
Age group vs type of spasm	0.380	Not significant
Sex vs type of spasm	0.465	Not significant
Mode of delivery vs type of spasm	0.225	Not significant
Birth asphyxia vs type of spasm	0.100	Not significant
EEG findings vs type of spasm	0.461	Not significant
MRI findings vs type of spasm	0.171	Not significant

term morbidity. Early identification and intervention are therefore essential components of management. (1,3,7,10)

ACTH therapy demonstrated favorable efficacy in achieving seizure control. Complete seizure remission was achieved in all patients with extensor spasms, while 74.2% of patients with flexor spasms and 54.5% of patients with mixed spasms achieved seizure freedom. Hormonal therapy remains one of the most effective first-line treatments for infantile spasms and is recommended by international guidelines. (7,10)

The International Collaborative Infantile Spasms Study

Table 5: Distribution of subjects according to Seizure control with ACTH and type of spasm

Type of spasm	Controlled n (%)	Partially Controlled n (%)	Not Controlled n (%)
Extensor (n=8)	8 (100)	0	0
Flexor (n=31)	23 (74.2)	5 (16.1)	3 (9.7)
Mixed (n=11)	6 (54.5)	1 (9.1)	4 (36.4)
p value	0.083	Not significant	

Table 6: Distribution of subjects according to Developmental milestones after follow up and type of spasm

Type of spasm	Delayed development n (%)	Normal development n (%)
Extensor (n=8)	7 (87.5)	1 (12.5)
Flexor (n=31)	20 (64.5)	11 (35.5)
Mixed (n=11)	11 (100)	0
p value	0.043	Significant

(ICISS) demonstrated superior outcomes with combination hormonal therapy and vigabatrin compared with hormonal therapy alone, further emphasizing the importance of early aggressive treatment. (11) Evidence-based recommendations have also highlighted that prompt initiation of first-line therapy is associated with improved seizure outcomes and may positively influence developmental prognosis. (5,7,10)

Recent evidence has suggested potential benefits of alternative therapeutic approaches. Ketogenic diet therapy has shown efficacy in selected patients with refractory infantile spasms, particularly when hormonal therapy and vigabatrin fail. (12) Surgical intervention may also be beneficial in carefully selected children with focal structural lesions and medically refractory epileptic spasms. (4,5) However, these treatment modalities were not evaluated in the present study.

A statistically significant association was observed between seizure semiology and developmental outcome following treatment ($p=0.043$). Children with extensor and flexor spasms demonstrated better developmental outcomes than those with mixed spasms. Although seizure freedom is an important therapeutic goal, long-term developmental outcome remains equally important in determining overall prognosis. (5,6,7,10)

No significant association was identified between spasm type and age, sex, mode of delivery, birth asphyxia, EEG findings, or MRI abnormalities.

CONCLUSION

Infantile Epileptic Spasms Syndrome (IESS) remains an important developmental and epileptic encephalopathy of

infancy, predominantly affecting children between 6 months and 2 years of age. Birth asphyxia and developmental delay were the most common associated factors, while flexor spasms constituted the predominant seizure type. EEG and MRI abnormalities were frequently observed. ACTH therapy achieved favorable seizure control, particularly in children with extensor and flexor spasms, highlighting its effectiveness as a first-line treatment. Early diagnosis and prompt initiation of therapy are crucial for improving seizure and developmental outcomes. (7,10,11)

The strengths of the present study include prospective data collection and uniform treatment with ACTH. The study was limited by its single-center design, relatively small sample size, and limited long-term neurodevelopmental follow-up. Comparative evaluation of ACTH with vigabatrin, oral prednisolone, ketogenic diet therapy, and surgical interventions was not performed. Future multicentric studies with larger cohorts and longer follow-up periods are needed to better define prognostic factors and optimize treatment strategies in children with Infantile Epileptic Spasms Syndrome. (5,11,12)

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